Assessing Attitudes towards Biodiversity Conservation among Citizens on Bioko Island, Equatorial Guinea and Cameroon

A Thesis
Submitted to the Faculty
Of
Drexel University
By
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In partial fulfillment of the
Requirements for the degree
Of
Doctor Philosophy

May 2016

Dedication

I would like to dedicate this dissertation to the person who gave me this once in a life time opportunity, Gail Hearn, PhD., and also to the initiative that she founded to protect the unique biodiversity of my lovely island, the Bioko Biodiversity Protection Program (BBPP)

Acknowledgements

Funding and support for this project was provided by the Mobil Equatorial Guinea, ExxonMobil Foundation, National Science Foundation, the Bioko Biodiversity Protection Program and the Central African Biodiversity Alliance.

I am grateful to the Government of Equatorial Guinea, especially the Ministry of Fisheries and the Environment for giving me the permission and opportunity to have an internship there, during which I was able to interview employees and gather hard copies of existing legislation.

I am also thankful to the Government of Cameroon through the Ministry of Scientific Research and Innovation for issuing the right permission to my field assistants in order for them to be able to administer our questionnaires in Cameroon.

I am thankful to the National University of Equatorial Guinea, particularly the Department of Environmental Sciences for providing with some of the most essential resources (permits, field assistants, transportation and faculty support) to conduct my research on Bioko Island.

I am also grateful to the High Institute of Environmental Sciences in Yaoundé, Cameroon for assisting me in the administration of my questionnaire carried out by two of its students.

I would like to thank a long list of individuals whose support, effort, motivation and guidance contributed immensely in my life and career. In the attempt of citing their names, I will very likely forget about certain people involuntarily. I still want to say thank you to you in advance if your name is missing from the list below. As the saying goes, “it takes a village”. I am extremely grateful to:

My advisor and mentor, Gail Hearn, for giving me the opportunity to join the Bioko Biodiversity Protection Program and then allowing me to grow as an employee within the organization, for giving subsequent opportunities (summers 2008 and 2009) to come to the United States to work on my English language skills; most importantly, for giving me a super unique opportunity to come to the United States to do my PhD at Drexel University and for being such a good mentor. Your passion, encouragement, willingness to listen, advice, guidance, motivation, patience, support, and teachings will always live with me. You inspire me in countless ways.

My committee chair, Michael O’Connor, for devoting part of his already scarce time to assist and guide me with the data analysis of my questionnaires, for always being available when I needed help, either with my research or any school related consultation, for teaching me every little thing I know about data analysis.

Wayne Morra, for agreeing to be part of my committee and always being available to offer his unique guidance during all the committee meetings. Also, for his friendship and encouragement since we have known each other.

Rachel Reynolds, for agreeing to be part of my committee and her availability in attending all committee meetings, where she shared her unique expertise on social studies and issues related to Cameroon with all of us with the solo idea of enriching my work.

Katy Gonder, for agreeing to join my committee and supporting my research in Cameroon; for supporting me in her lab as a research assistant for a couple of quarters during which I was able to devote a chunk of my time on my research, for encouraging me while working on my dissertation. Also, for giving me the opportunity of being able to continue working with her; this time, as a postdoctoral research fellow.

Drew Cronin, for agreeing to be part of my committee and offering his expertise in many ways towards the improvement of my research; for offering me his friendship, motivation, encouragement and assistance in many aspects of my life, either as a BBPP employee in Bioko Island or as graduate student at Drexel University. "*I am glad the cows did not kill us when they chased us in the pastures of Moka*".

Peter Hearn, for welcoming me in his family with open arms and allowing me to stay in his house in the summers of 2008 and 2009 when I came to the States to work on my English language skills, for teaching me about American culture and Philadelphia history, for inviting me over to his house to spend many winter solstices with his adorable grandchildren (Cisco and Jasper); the hat making experience was unique, surely, I will miss it a lot, but I will try to implement something similar in my family. In addition, for his encouragement, consistent follow up, motivation and support regarding my education since my arrival in the United States. I received the same appreciation from your entire family (Elizabeth, Josephine, Bob, Sylvia, Tammy, Jon, Jim, Tim, David, Otis) about which I am very grateful. 519 Pine Street, Philadelphia, 19106. It always feels like home when I step in that house.

The Johnson Family (Pete, Mary, Chris, Jeff, Kevin, Ethan and Sophia), for offering me their love, support, encouragement and motivation throughout my entire career here at Drexel University, for flying me out of Philly just to spend my holidays (Christmas, Thanksgiving) with them. Upon my return from those trips, I always felt more energetic to get back to school. Also, for keeping in touch and always doing a close follow up on my career development, for having Jeff come over to Philly almost every summer to check on me prior to my departures for my field trips in Equatorial Guinea, for getting me a surprise suit for my defense and attending my hooding and graduation ceremonies.

My family (Bocuma Meñe), for taking care of me in my childhood, planting the early seeds of my education, allowing me to follow my dreams without any external pressures; for their love, support and encouragement in everything that I do.

José Manuel Esara Echube, for supporting my research by providing me with the most appropriate permits to administer my questionnaires across Bioko Island.

My cousin, Maximiliano Fero Meñe, for assisting me in the selection of my two field assistants (Amancio Motove Etingüe and Francisco Mitogo Micha) who did a great job in

administering my surveys. Also, for his friendship, guidance, encouragement and support in many aspects of my personal and professional life.

Santiago Francisco Engonga, for giving me the green light to have two internships (summers 2011& 2012) at the Ministry of Fisheries and Environment (MFE), for the existing fruitful relationship between the department of environment in the MFE and the Bioko Biodiversity Protection Program.

Hilton Oyamaguchi, for his friendship, encouragement and assistance with the design of certain maps for my dissertation. Hilton always calls my name when he passes by my apartment on 3905 Baring St., and then I yell back his name "*Oyamaguuuuuuuchiiiiiiiii*". I will definitely miss it.

Paul Sesink Clee, for assisting me with the design of most of my maps considerably and for his accessibility, patience and guidance throughout the entire process. Also, for his friendship and encouragement over the years. I always felt like I knew what I was doing after talking maps with Paul. Even once I leave for Africa I will always reach out to you if I need help with maps, because your skills are unmatchable. I bet at this point you already know how I call your name when I need help-Paulllllllllll.

Patrick McLaughlin, for his friendship, encouragement, sarcastic personality and guidance over the years, for being a good captain resulting in us winning the Intramural Championship in 2011. Also, for allowing me to move into his house when I started my PhD program and then he ended up handing out most of his personal belongings (bed, mattress, kitchen utensils, etc.) to me; for giving me the permission to FedEx his titanium spoon to him, which never showed up in his mail box.

Jacob Owens, for being such a good friend to the point that he invited me to his place to spend Thanksgivings with his beloved wife Jane, who always treated me nicely and respectfully; for agreeing to take over for two months as manager of the Moka Wildlife Center so that I could come to the States to improve my English language skills. For his encouragement, motivation and guidance over the years. Also, for vising my dad in my hometown Ruiché while I was here in the States studying.

Maggie Cunningham, for her friendship, encouragement, guidance, motivation and effort over the years. Most importantly, for being patience and super helpful in guiding me about the most efficient approach necessary for the teaching of my labs and recitations.
Heidi Rader, for her friendship, love, encouragement and guidance over the years, for teaching me some administrative skills and being a good listener. For her continuous dedication in the production of authentic environmental education materials for the children of my country, which will surely have its impact years to come. Also, for immortalizing my name and voice in some of her works, for making my delightful graduation cake and setting up the place. I will never forget about our travelling experience from Cameroon to Philly during which we faced so many unknowns (changes of flights, missing flights, credit and debit cards not working, etc.). You rock, Heidi!!!

Dane Rader, for your friendship and encouragement and for picking me up at the Philadelphia airport the first time I came to the States in 2008, for introducing me to your beloved family. I will always keep in touch.

Matt Mitchell, for his friendship, encouragement and guidance over the years. For assisting me with the coordination of my Cameroon survey. Also, for supporting Real Madrid and Barcelona at the same time; as you already know, my favorite team, Barcelona, is currently driving me crazy because they keep winning championships! Dr. Mitchell. Alrrrrrrrrrrrrrrrrrrrright, ah, ah, ah.

Janina Dordel, Dana Venditti, Bryan Featherstone, David Montgomery, Steve Miller, Miguel Perez, Ekwoge Enang Abwe, for your friendship, encouragement, motivation and any useful guidance or help provided to me during our time together. You are, will always be, a major component of my professional development.

Hall Morra, for his friendship and encouragement and for giving me the first of opportunity to join BBPP as a volunteer in Aula 5 (BBPP's computer lab) at the National University of Equatorial Guinea (UNGE). I enjoyed going out with Hall to the Senegalese Restaurants (Hay Comida!) in Malabo, where we would always have a meal of fried chicken, either with rice or fried plantains, with lots of spicy in it, making us to sweat buckets. Good old times!

Amy Lehman Etingue, Heidi Ruffler, Elizabeth Congdon, Amber Geller, Jessica Weinberg; for your friendship, encouragement and motivation over the years. For giving me the opportunity to work with you when you were involved with BBPP on Bioko Island; particularly, Jessica Weinberg who taught me many things (writing reports in English, use of Excel and Microsoft Word, accounting, dealing with visitors and students, organizing field trips, making sure the inventory is updated etc.).

Sally Vickland, for her friendship, guidance and motivation over the years. For being a good and competent coworker and for coordinating many essential activities that benefited so many of us while she was BBPP's in country manager.

Jennifer & Jim Seale, for being a major player in the establishment of the BBPP, for their encouragement, love, support and motivation during my years at Drexel University. For visiting me as often as possible when I was based at the Moka Wildlife Center (MWC), where they always brought me goodies (delightful laffy taffy candies, sandwiches, cookies, soft drinks. Etc.).

Filemón Etingüe Rioso, for his friendship and encouragement over the years, for paying me several surprise visits in Philadelphia.

Amancio Motove Etingüe and Francisco Mitogo Micha, for their time, commitment, effort, availability and reliability in assisting with the administration of my surveys in Bioko Island over the course of two subsequent field seasons (summers 2013 and 2014). My research would not have been possible without their help.

Shaya Honarvar, for her friendship, encouragement, effort, motivation and guidance during both my time as an assistant manager at the MWC and as a PhD student at Drexel University.
Stephen Woloszynek, for his friendship, encouragement and guidance over the years; especially, for assisting me when I needed some guidance with statistics.

Kamogne T. Cedric Thibaut and Fadimatou Amadou, for their time, commitment, effort, availability and reliability in assisting with the administration of my 2015 survey in Cameroon. My study in Cameroon would not have taken place without their assistance.

Dominica Njom, for assisting with the printing of questionnaires, obtaining permits, coordinating with field assistants and doing regular follow ups regarding the implementation of my 2015 Cameroon survey.

My academic advisor, Susan Cole, for being approachable and kind and always making sure I was taking the right courses.

My girlfriend, Dulce, for her love, patience, kindness, encouragement and guidance that she has shown to me since the beginning of our relationship.
Aleister Saunders, for his encouragement and motivation during my time in the Drexel PhD program.

Laura Cronin and Janell Black, for being good and competent lab coordinators and assisting me with any lab related matters in an efficient manner. Also, for their friendship and encouragement over the years.

Daniela Scarelli, for her friendship, encouragement and motivation over the years and for inviting me to her Christmas parties. For giving me the opportunity to teach classes in the Bioko Study Abroad program.

I am grateful to have met and shared some special moments with some of my colleagues at Drexel University: Steven Henri Pearson, Jules Winters, Drew Smith, Aliki Panagopoulou, Samir Patel, Dane Ward, Kevin Smith, Yuxiang Fei, Kaitlin Baudier, Vivian Allahyari, Anna Jaworski. Shauna Henley, Noga Neeman, Patricia Borruso, Jack Suss, Lori Lester, Abby Dominy, Janell Black, Karen Sullam, Alexis Layman etc.

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Abstract

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The unsustainable harvest of wild animals (bushmeat) from the forests of Africa is rapidly endangering populations of many larger mammalian species. Bioko Island, Equatorial Guinea, represents an extreme situation, with bushmeat priced higher than elsewhere, and the remaining mammalian species, especially the seven monkey species on the island, increasingly endangered. In this dissertation I have examined the demand side of the bushmeat trade on Bioko Island, ascertaining details of bushmeat preference in the general population and beginning to measure the efficacy of several standard conservation outreach strategies in mitigating the demand. I conducted two anonymous structured questionnaire surveys on Bioko Island and one similar questionnaire survey in the forested areas of Cameroon by recruiting participants from public places in cities and villages: An initial trial survey (Survey I; N=322) was conducted in 2013 on Bioko Island with mostly urban participants; a revised survey (Survey II; N=393) was conducted in 2014 on Bioko Island with mostly rural participants; and, an additional modified survey (N=213) was conducted in 2015 in Cameroon. All surveys included a reasonably representative cross section of the general population with adequate distribution of respondents of different gender, age, location (urban or rural), occupation, socio-economic status, educational level and ethnic group.

Bushmeat was the overwhelming first choice meal of respondents on Bioko Island (57% in Survey Version I; 69% in Survey Version II), but in Cameroon fish was the first choice (26%), followed by bushmeat (24%). There were no differences in bushmeat preference rates between the two major ethnic groups (Fang or Bubi) on Bioko Island; Fang respondents living in Cameroon had a lower bushmeat preference rate, similar to other ethnic groups living in Cameroon, rather than the high rate typical of Bioko Island. I did find that the preference for particular bushmeat species was different for different ethnic groups, and the Fang preference for primates on Bioko Island was especially noteworthy given the endangered status of many of Bioko's monkeys. The surveys included questions about laws protecting wildlife, about awareness of local outreach programs meant to sensitize the public to the plight of endangered wildlife, and questions about the influence of these programs on public support for wildlife conservation. In all surveys, respondents were generally aware of either the laws or the outreach programs and were supportive of wildlife conservation, especially the enforcement of laws protecting wildlife. As a result, the following recommendations for action by the government of Equatorial Guinea were made:

- Enforce existing laws and treaties that protect biodiversity by 1) establishing teams of well-trained and well-paid forest guards in the protected areas, and 2) penalizing (fines for vendors) the illegal sale of protected species as bushmeat in the market.
- Support the development of Equatorial Guinea's protected areas and encourage the subsequent implementation of an innovative eco-tourism experience based on the country's unique biodiversity.
- Encourage the development of domestic sources of fresh protein, especially fish and chicken, in Equatorial Guinea.

Chapter I: Why Bioko Island is important to the world's biodiversity

Natural History of Bioko Island and its relationship to Rio Muni

The rapid and unnatural loss of biodiversity from the planet Earth is a widely recognized crisis. At first, there were warnings from scientists (Wilson 1989; Ehrlich & Wilson 1991), but now biodiversity loss is increasingly the topic of everyday conversation because of recent popular books like Elizabeth Kolbert's "The Sixth Extinction: An Unnatural History," (Kolbert 2014). It is generally accepted that this crisis has been caused by human activities such as habitat destruction, unsustainable hunting and harvesting, climate change, invasive alien species and pollution, all activities that have driven the extinction rate to more than 1000 times its background rate (Myers et al. 2000).

Conservation biologists have proposed a number of strategies to mitigate biodiversity loss in the face of human activities. One strategy, proposed by Conservation International, was to focus conservation efforts in those areas of Earth with the greatest species richness. To accomplish this goal, 25 biodiversity "hotspots" were identified, which accounted for only 1.44% of Earth's terrestrial area (Myers et al. 2000). However, these rapidly shrinking hotspots contained 60% of the species on Earth. These were Earth's richest and most endangered terrestrial ecosystems and they were prioritized for immediate protection. One of these hotspots was the Guinean Forest, which extended along the West African coast eastward from the western border of Sierra Leone to the Sanaga River in Cameroon. At its eastern end it encompassed the four Gulf of Guinea Islands, including the two that are part of the country of Equatorial Guinea, Bioko Island (formerly Fernando Po) and Annobon Island (Myers et al, 2000).

The tiny country of Equatorial Guinea (28,051 km²) makes a disproportionally large contribution to the world's biodiversity. This high biodiversity comes as a result of the European-created boundaries that grouped an oceanic island (Annobon), a continental island (Bioko) and a rectangle of African mainland (Rio Muni) into the country of Equatorial Guinea (Figure 1.1). Bioko Island makes up less than 10% of the country of Equatorial Guinea, but it makes a disproportionally large contribution to that country's biodiversity.

A good example of Equatorial Guinea's biodiversity and the factors at work in producing its high biodiversity tallies can be found in a consideration of the primates that live in the country. Equatorial Guinea is astonishingly primate rich (23 native non-human primate species), ranking fourth among all African countries, even though the higher ranking countries (Democratic Republic of Congo, 34 species; Cameroon, 31 species; Nigeria, 26 species) have an area at least 15 times greater (Oates 1986) (Table 1.1).

The distribution of primate species in Equatorial Guinea demonstrates the importance of Bioko Island. Although Rio Muni, the mainland part of the country, claims 17 native primate species, only 3 of those species can also be found on Bioko Island, which lies 160 km offshore to the northwest. Bioko claims a total of 11 native primate species, one of which is endemic to the island, and six (monkeys) of which it shares with the nearby Cameroonian mainland (35 km offshore), but not with Rio Muni to the more distant southeast. Rio Muni has no endemic primate species, but does share nine monkey species and two great ape species with the neighboring countries of Cameroon and Gabon (González Kirchner 1994; Oates & Nash 2011) (Table 1.2)

Why does Bioko Island share three monkey species with nearby Cameroon but not with Rio Muni, which is less than 100 km south along the Cameroon coast? The answer lies with a nearby boundary between two major African biogeographical regions on the mainland. The Sanaga River, which flows into the Gulf of Guinea only 60 km directly east of Bioko Island, separates the Guinean Forest, which extends westward from the Sanaga to Senegal, from the Congolian Forest, which extends southward from the Sanaga to Angola and Zambia. The Sanaga River forms the range boundary of many primate species (Linder et al. 2012). Using the Bioko Island monkeys as an example, drill monkeys are only found north of the Sanaga while their close relative mandrill monkeys are only found south of the Sanaga(Oates & Nash 2011). Likewise, the red-eared monkey, *Cercopithecus erythrotis erythrotis,* and Preuss' monkey, *Allochrocebus preussi insularis,* are typically limited to north of the Sanaga River, while the black colobus is found only south of the Sanaga (Oates & Nash 2011). The Bioko Island monkeys also illustrate the distribution of mainland affinities. More of Bioko's species are characteristic of the Guinean Forest rather than the Congolian Forest (Table 1.2).

Bioko Island has fewer monkey species than nearby mainland because Bioko is a continental island, separated from the rest of Africa only 12,000 years ago as sea level rose at the end of the last Ice Age (Moreau & Moreau 1966). For considerable time before then, Bioko was a part of the mainland and presumably had all the same species that are typically found in the coastal rainforests of Cameroon (Table 1.3). Now it has far fewer species, the result of several processes, some natural and some man-made. Once it became a continental or land-bridge island, it was susceptible to the natural process of "relaxation," the loss of species due to smaller available area (Ford et al. 2009). Another natural process, "super-

saturation," where species crowd into a smaller area than can support them, could have happened in the past, or may still be happening today (Schippers et al. 2001). It has been calculated that a tropical forest area the size of Bioko should only support five primate species, and that eventually the present eleven species will dwindle to a lower number (Cowlishaw 1999).

Man-made processes that influence species richness usually result in the decline in the number of species. In tropical Africa, habitat destruction in the form of logging is a common cause of species endangerment (Clark et al. 2009). On Bioko Island, most habitat destruction is limited to the lowland forest on the northern half of the island (Zafra-Calvo et al. 2010a). These areas were cleared (except for a few large shade trees) for cacao plantations more than 100 years ago, and the area was renowned, before independence in 1968, for producing the world's best cacao which made the world's best chocolate (Sundiata 1996; Liniger-Goumaz 2000). After independence, many plantations were abandoned and returned to secondary forest, a benefit to many native species, including the primates (Butynski & Koster 1989a). Attempts to log Bioko's forests were generally unsuccessful because of the steep terrain and relative lack of good timber (Sundiata 1996). The monsoon forests that characterize Bioko's lowlands have relatively few large trees (Zafra-Calvo et al. 2010a). Certain tree species have been exploited for specific uses, like extracting a pharmaceutical to treat prostate gland enlargement from the bark of the African cherry tree, *Prunus africana*, which grows at higher elevations on Bioko Island (Navarro-Cerrillo et al. 2008).

Bioko is also a part of the Cameroon volcanic line, a chain of volcanoes that stretches from the lake Chad to the Bambouto and Oku Highlands in Cameroon, southwest to include

the oceanic islands of Sao Tome, Principe and Annobon, possibly even St. Helena Island (Fitton 1980). Mt. Cameroon, at 4,095 m asl, is West Africa's highest mountain, and Bioko's Pico Basile (3008 m asl) is often considered to be the second highest (Suh et al. 2003a; Yamgouot et al. 2015). These two peaks, plus the nearby Gran Caldera de Luba (2.261 m asl) and Pico Biao (2.010 m asl) on Bioko form high altitude "sky islands" where cooler temperatures lead to distinct bands of vegetation: 1) tropical crops (cacao, malanga, plantains, etc.) and low-land rainforest from sea level up to 800 m asl; 2) montane rainforest from 800 to 1400 m asl; 3) *Schefflera* forest from 1400 to 2600 m asl; 4) Heath and grassland from 2600 to 3000 m asl (del Val & Pérez 1996). These higher elevations, with their different vegetation support a different collection of animals than those found in lowland rainforest (del Val & Pérez 1996; Sunderland & Tako 1999). Again using Bioko monkeys as an example, Preuss's monkey is found primarily in these higher altitude habitats (>800 m asl) with montane vegetation while the similar putty-nosed monkey lives at lower altitudes in rainforest (González Kirchner & Kirchner 1994).

Mt. Cameroon is still a very active volcano with frequent major eruptions, but Pico Basile is somewhat less active with minor eruptions occurring in 1923, 1903, 1898, and 1222 (Lentz 1999; Sigurdsson et al. 1999; Suh et al. 2003b). Although these volcanoes are arranged in a line, they are not the result of a tectonic plate moving over a hot spot, like the Hawaiian Islands, but instead are formed somewhat randomly along the edge of a plate. Therefore the ages of the volcanoes in the line are not in chronological sequence. Mt. Cameroon and Pico Basile are currently the most active part of the line (Piper & Richardson 1972). The exact age of Pico Basile is uncertain, but most sources estimate that it is at least 1

Ma, more than enough time for the evolution of distinct plant and animal species (Piper & Richardson 1972).

The Cameroon Volcanic Line and the highlands and mountains it created were also important factors in the evolution of biodiversity in the Gulf of Guinea region. During the numerous Pleistocene ice ages, these highlands became "forest refuges" during drier periods, places where forests persisted when grassland displaced lower elevation rainforest. These repeated cycles of isolation are thought to have contributed to the many species of primates, especially monkeys, found in tropical Africa (J. Kingdon, 1997). Even though Bioko has been isolated most recently from mainland Africa for only 12,000 years, it could well have been an island at numerous times during the Pleistocene, and certainly functioned as a higher elevation refuge, causing an island-like isolation even while part of the mainland. As a consequence, Bioko Island has a level of endemism far greater than what could evolve in 12,000 years.

Bioko's primates also illustrate the levels of endemism: Although there is only one endemic primate species (Pennant's red colobus, *Procolobus pennantii*) on Bioko Island, five of the remaining 10 primate species are endemic at the subspecies level (Grubb et al., 2003). For mammals overall, the situation is similar with 65 mammalian species existing on Bioko, of these 19 are either endemic species or subspecies (Butynski & Koster 1994; Zafra-Calvo et al. 2010b). Eisentraut's mouse shrew, *Myosorex eisentrauti*, is another endemic species (Table 1.3). For birds, there are two endemic species, the Fernando Po speirops, *Speirops brunneus*, and the Fernando Po batis, *Batis poensis*, and at least 33 subspecies endemic to the island (Pérez et al. 1994). Powell et al (2014, *unpublished data*) recently reported new bird records (Klass's Cuckoo, *Chysococcyx klaas;* Slender-billed Greenbul, *Stelgidillas*

gracilirostris; Fernando Po Batis, *Batis poensis*) inhabiting high elevations in Bioko Island not previously published. Excell (1973) reports a total of 1105 plant species for Bioko Island, of which 39 are endemic species (Exell 1973).

Bioko's three high volcanoes also intercept the prevailing southeastern trade winds, resulting in heavy rainfall along the southern coast of the island (11,000 mm/yr.) and a rain-shadow (2,300 mm/yr.) along the northern coast where the capital city of Malabo is located (Nosti 1947). This difference in rainfall creates additional microhabitats and opportunities for survival for smaller species. Equally important are the opportunities provided by a lack of human disturbance. The heavy rainfall along the southern coast and the cooler temperatures at higher elevations have discouraged farming and human settlement and so very few people live in the southern part of Bioko. Although the village of Moka on the slopes of Pico Biao has a successful truck farm industry, raising vegetables that can only be grown in cooler temperatures, other attempts at commercial agriculture south of Moka have failed due to torrential rainfall and a corresponding lack of sunshine. The only settlement south of Moka is the small Bubi village of Ureca with fewer than 80 inhabitants located 0.5 km from the southern coast; all other villages and plantations, including an attempted plantation at Ureca, have been abandoned.

When the unique biogeography of Bioko Island and its endemic wildlife are added to the wildlife of Rio Muni, Equatorial Guinea becomes a nation of biodiversity opportunity. Rio Muni adds a long list of Congolian Forest megafauna (Table 1.3). In addition to the two great apes (chimpanzee and gorilla) and numerous monkey species, there are leopards, forest elephants, hippopotamus, forest buffalo and eleven additional species of antelope. Rio Muni itself has no known endemic species, but at least three of the mammalian species it shares

with southern Cameroon and Gabon are endangered (lowland gorilla, chimpanzee and forest elephant) (Tables 1.2 &1.3). However, the country of Equatorial Guinea (Rio Muni) makes up only a small part of the range of these endangered species. Because of extensive logging, it is unlikely that Rio Muni will serve as a refuge for these large forest mammals.

The conservation situation on Bioko Island is very different from that in Rio Muni. As mentioned above, it was included in the Guinea Forest hotspot, one of the original 25 hotspots identified by Conservation International (Myers et al. 2000). More recently, scientists affiliated with World Wildlife Fund designated Bioko Island as a Class I endangered African ecoregion, namely an ecoregion that is likely to change into a critically threatened region in less than 20 years (Burgess et al. 2006).

Human activities have probably already resulted in several notable extinctions on Bioko Island. The forest buffalo *Syncerus caffer* is thought to have disappeared from the island about 1895, the result of over-hunting (Butynski et al. 1997). The river otter *Aonix congica* was reported to be on the island in the late 1800's by the British writer and explorer Mary Kingsley (1895), but the specimen of record in the British Museum is thought to have been accidentally attributed to Bioko Island. The palm civet *Nandina binotata* was reported to exist on Bioko in the 1950's by Father Basilio, a Catholic priest working on the island, but his record is contradictory (Basilio, 1952). In addition, just recently Hoffman et al (2015) found no evidence of the existence of the Palm civet *Nadina binotata* on Bioko Island, however, they reported about the potential existence of a second unidentified small arboreal carnivore on the island (Hoffman et al. 2015).

Other species may have disappeared from Bioko Island in recent years, or may simply have become very scarce. The endemic Eisentraut's mouse shrew has not been recorded

since 1998 (IUCN 2016). An endemic fish, the Santa Isabel killifish, *Fundulopanchax oeseri*, has not been reported from its native rivers near Malabo since the 1970's (IUCN 2016). Owen's chameleon, *Triceros oweni,* which was originally named from Bioko Island in 1831, has not been reported recently from its habitat in lowland rainforest although it remains common on the mainland. Because its habitat coincides with habitat required for the commercial cacao crop, it may be the victim of habitat destruction during the 1900's. It is excluded from higher elevations by competition from the endemic Bioko montane chameleon, *Triceros feae,* which is common at higher elevations (Chiu 2013).

Again, Bioko's primates provide a good example of current levels of endangerment. Of the seven species of monkeys whose range includes Bioko, the Red List of the World Conservation Union (IUCN 2016) lists one species as critically endangered (Pennants red colobus), two as endangered (drill and Preuss's monkey) and two more as vulnerable (black colobus and red-eared monkey). The final two species (crowned monkey and putty-nosed monkey) have large mainland ranges and are listed as least concern. However, many of these monkeys have a distinctive Bioko Island subspecies, and at the subspecies level, those endemic populations frequently have an IUCN rating that reflects greater possibility of extinction (Table 1.4)

In addition to primates, Bioko is recognized for several other endangered species. Four species of endangered marine turtles nest on its relatively undisturbed southern beaches: leatherback, *Dermochelys coriacea*; green, *Chelonia mydas*; hawksbill, *Eretmochelys imbricata*; and, olive ridley, *Lepidochelys olivacea*. Rare forest birds, including the bare necked rock fowl *Picathartes oreas,* are found in the pristine forests on the southern end of the island (Table 1.4).

Attempts at biodiversity conservation originating outside Equatorial Guinea

International and foreign government agencies:

Because Bioko Island has been recognized as an important site for biodiversity, attempts to preserve that biodiversity have often originated outside of Equatorial Guinea. Even before Equatorial Guinea was granted independence from Spain in 1968, the Spanish government had taken steps to set up protected areas: Pico de Santa Isabel Strict Faunal and Botanical Reserve on Bioko (Harroy 1972) and three reserves in Rio Muni: Monte Raices, Monte Alen and Rio Ekuku Game Reserves (IUCN 1992).

The Spanish had already taken steps to prevent over-exploitation of timber resources. In the 1930s, intensive unregulated logging was already a concern for Governors in Spanish Guinea. In the late 1940s, the Spanish government established mechanisms towards avoiding forests depletion of their most harvested timber, okoume wood, by putting a 30% allowance on its annual harvest (Fegley 1989)

The Spanish government continued to sponsor conservation projects in Equatorial Guinea after independence, often in association with Asociación Amigos del Coto de Doñana (Friends of Doñana, the well-known national park in the south of Spain).

From 1985 until 1992, with the support of the Spanish Technical Cooperation Agency, the Research and Nature Conservation Programme in Equatorial Guinea was established and its management were in the hands of the Asociación Amigos del Coto de Doñana (Castroviejo et al. 1994). The major aims of the project were as follow: 1) update adequate legislation; 2) create a Museum of Natural History; 3) promote scientific research; 4) set up a network of protected natural areas; 5) promote Equatorial Guinea's participation in international forums; 6) foster environmental education; and, 7) training of equatorial

guinea personnel (Castroviejo et al. 1994). Amigos del Coto de Doñana succeeded in implementing most of its objectives with the exception of the creation of a museum of natural history, which never took place (Castroviejo et al. 1994). The Research and Nature Conservation Programme in Equatorial Guinea's major achievement was the legal support and design of Law No8/1988 (December 31), regulating Hunting, Wildlife and Protected Areas (Castroviejo et al. 1994).

The European Union has also provided conservation funding. In 1995, the project Conservation and Eco-development of the southern part of Bioko Island was launched and it received funding from three institutions: the Spanish Agency for International Cooperation, the European Union and the Canadian Cooperation (Zafra-Calvo et al. 2008). The Asociación Amigos del Coto de Doñana and Asociación Amigos de la Naturaleza de Guinea Ecuatorial were in charge of implementation (Zafra-Calvo et al. 2008). The project had seven objectives: 1) organization and installation of surveillance and monitoring equipment in the protected area of the South of Bioko Island; 2) allocate the protected area with resources and infrastructure necessary to perform the tasks of monitoring and management; demarcation and signaling, control posts, grocery stores, multi uses centers, experimental farms; 3) conduct biodiversity studies (specifically on primates, sea turtles and hunting) and necessary zoning to put together a declaration and classification norm of the protected area; 4) training of technicians in areas related to conservation and management of natural resources, surveillance, tour guides, administrators and others; 5) local public awareness campaigns; 6) development of breeding wild species (giant African snail, Emin's pouched rat) and domestic goats as alternative protein sources to wildlife; 7) establishment of a self-sufficient system for the supply of basic products for locals living near the surroundings of

the protected area (Zafra-Calvo et al. 2008). The whole project halted its operations in 1999 (Zafra-Calvo et al. 2008).

In 1992, the European Union funded Programme for the Conservation and Rational Use of Central African Forest Ecosystems (ECOFAC), covering seven countries in the region (Congo, Cameroon, Central African Republic, Equatorial Guinea, Gabon, Sao Tome and Principe and Democratic Republic of Congo), incorporated Equatorial Guinea in its initiative(Castroviejo et al. 1994). One protected area in the country was chosen as the pilot project; it was the National Park of Monte Alen in Rio Muni (Castroviejo et al. 1994). Two agencies (AGRER and AGRICONSULTING) were responsible for the implementation of the ECOFAC project in Equatorial Guinea and were charged with the goals of 1) Preserving the protected area's forests, avoiding logging concessions and wildlife hunting; and, 2) improving the living conditions of local population (health dispensaries, grocery stores). These were the project's main achievements (Zafra-Calvo et al. 2008). For tourist accommodation, a ten-bedroom lodge was built at Monte Alen (de Wasseige et al, 2008). In 2001, with the technical and financial assistance of the ECOFAC program, the Monte Alen National Park was increased in size from 1004 km^2 to 2000 km^2 (EC 2001).

Additional European Union Development funds supported other projects based in Rio Muni. The project on Conservation and Rational Use of Central Africa's Ecosystems (CUREF) was launched in Equatorial Guinea from 1996 until 2001 and it was sponsored by the European Union(Zafra-Calvo et al. 2008). The most notable achievements of the CUREF project were the design of Law No4/2000, regulating protected areas in Equatorial Guinea and the establishment of a National Herbarium in Bata (Zafra-Calvo et al. 2008)

In some cases, the government of Equatorial Guinea has been resistant to biodiversity conservation assistance from outside entities. On June 23, 2000, the Cotonou Agreement was signed between the European Union and the African, Caribbean, and Pacific Group of States (2005). Equatorial Guinea, as a signatory party, was given funding to support a wide range of projects from the 8th and 9th European Union Development Funds (European Commission, 2015). However, Equatorial Guinea was excluded from benefiting from the 10th and 11th European Union Development Funds (EDF), given that it voluntarily decided not to sign the twice (2005 and 2010) revised Cotonou Treaty. Currently the 11th EDF covers the period of 2014-2020 and it allocates €350 million to Central African countries (with the exception of Equatorial Guinea), of which €88 million are directed towards sustainable development of natural resources and biodiversity (2015).

The United States government has also contributed to conservation efforts in Equatorial Guinea. Funding was through USAID under the Central African Regional Program for the Environment (CARPE), established in the mid-1990's. CARPE was present in six Congo Basin countries: the Democratic Republic of Congo (DRC); Republic of Congo; Central African Republic (CAR); Cameroon; Gabon; and, Equatorial Guinea (USAID, 2015). At first only the mainland part of Equatorial Guinea was eligible for participation because Bioko was ruled to be too far from "Central Africa," and so conservation efforts by the non-governmental organization (NGO) World Wildlife Fund (WWF) concentrated on Rio Muni.

WWF involvement in Equatorial Guinea began as early as 1986 when it co-sponsored, along with Zoo Atlanta and the Chicago Zoological Society a study on the distribution and conservation status of primates in Bioko Island (Butynski & Koster 1989b; Butynski &

Koster 1994), but after its initial CARPE involvement in Equatorial Guinea, WWF was re-assigned to other CARPE partner countries.

In 2003, the United States Government launched the Central Africa Regional Program for the Environment (CARPE) as an exclusive USAID/Central Africa Regional Operating Unit (USAID/Central Africa Regional, 2012) and the CARPE-funded NGO for Equatorial Guinea was Conservation International. It was headquartered in Bata, the mainland capital of the country. CI was put in charge of running the Monte Alen-Mont de Cristal Inselbergs Forest Landscape, a series of interconnected protected areas in Equatorial Guinea and Gabon (CARPE)(Mehlman et al. 2006). The Monte Alen Segment (Equatorial Guinea) of the Monte Alen-Mont de Cristal Landscape had some of the following achievements: 1) assisted the National University of Equatorial Guinea (UNGE) in the creation of the Faculty of Environmental Studies; 2) promoted scientific research towards the understanding of Monte Alen segment's biodiversity (flora and fauna); and, 3) aided with capacity building at Equatorial Guinea's National Herbarium in Bata (Mehlman et al. 2006). In 2012, the suspension of their operations and physical presence in Equatorial Guinea was announced and it was said that the reason was due to limited resources (H. Ruffler, *personal communication*, July 26, 2012)

The United States. Fish and Wildlife Service (USFWS) has been providing funding towards different conservation projects in Equatorial Guinea and this country has benefited from 13 grants between 2006 through 2013, totaling over $1,074, 334. Some of the funded projects were: 1) between the period of 2011 and 2012 ($24,999) the USFWS supported the Bioko Biodiversity Protection Program (BBPP)'s community based conservation project focused on sea turtles at Bioko Island, in addition to Rio Campo's marine turtle conservation

program in the mainland; 2) conservation strategies to protect the critically endangered Pennant's red colobus monkey, on Bioko Island, led by Drexel University; 3) conservation of Bioko Island's endangered amphibians, *Arlequins krebis* and *Didynamipus sjostedti,* undertaken by Drexel University.

Furthermore, the USFWS has funded other important projects on the mainland. USFWS supported Conservation International (CI) and the National Institute for Forestry Development and Protected Area Management (INDEFOR-AP) between 2010 and 2011 to carry out the first-ever large biological survey across Equatorial Guinea's mainland. USFWS (2010-2012) supported the Zoological Society of London (ZSL) to implement a bushmeat alternative pilot project in mainland Equatorial Guinea. Between 2007 and 2013 the USFWS has awarded $170,000 to INDEFOR-AP to support its marine turtle conservation program in the mainland Equatorial Guinea (USFWS, 2014).

United Nations Development Project and the Global Environmental Fund (UNDP & GEF), together with Conservation International as implementing NGO and the Ministry of Fisheries and Environment as government executive entity, launched several projects for the enhancement of biodiversity conservation in Equatorial Guinea, an effort that started in 2008 with the presentation of a project entitled "Strengthening the National System of protected areas in Equatorial Guinea for the effective conservation of representative ecosystems and globally significant biodiversity" an almost $600,000 project intended for 2008-2012. A program with the same title but with a larger budget of almost $2,000,000 was scheduled for 2010 – 2014. Another project that includes environmental protection, United National Development Assistance Framework (UNDAF) 2013-2017 covers three areas (socioeconomic wellbeing, democratic governance and sustainable environment with a total

budget of more than $55,000,000. Another GEF-funded project, scheduled for 2015 through 2020 is for the reinforcement of competencies and capacities for the future of protected area system. Many of the projects offered by UNDP/GEF have been met with implementation difficulties and the common outcome has been the organization of workshops, like the one that took place on June 1 and 2, 2009 in Bata, and most recently on April 9 and 10, 2015 also in Rio Muni.

Non-governmental organizations (NGO's) & not-for-profit organizations:

Two of the traditional four "elephants" of biodiversity conservation (World Wildlife Fund, Conservation International, Wildlife Conservation Society, and Nature Conservancy) were active in Equatorial Guinea because of the CARPE funding discussed above. The Nature Conservancy, coming relatively recently and selectively to Africa, has not had any programs in Equatorial Guinea. The African Wildlife Federation, also a major conservation organization that operates only in Africa, has also not had any projects in Equatorial Guinea. However, the Wildlife Conservation Society (WCS) has recently become involved.

The Wildlife Conservation Society, based at the Bronx Zoo (New York), has a marine project, Congo Basin Coast, which includes the shorelines of three African countries, Equatorial Guinea, Gabon and Congo. The program is managed by the WCS regional sea turtle coordinator, Angela Formia, who has been active in West African sea turtle conservation for many years. Her program in Rio Muni and Gabon was funded by US Fish and Wildlife Service. She inherited the additional West African programs formerly managed by French biologist Jacque Fretey.

Wildlife Conservation Society has launched a new program focused on Coastal Resources Management in Equatorial Guinea (2014-present) and the oil company Noble

Energy is its leading sponsor (INDEFOR-AP, 2014). The Instituto Nacional de Desarrollo Forestal y Áreas Protegidas (INDEFOR-AP) is the government executive entity for WCS's project (INDEFOR-AP, 2014).

The Zoological Society of London (ZSL), with its headquarters and operations in the mainland of Equatorial Guinea, launched its bushmeat research activities in 2002. It is sponsored by the Higher Education Funding Council in England, additionally some of its work received funding from other sources (Conservation International, Hess in Equatorial Guinea, USFWS, Rufford Foundation). Although primarily a research effort with a special emphasis on understanding the bushmeat trade in Rio Muni, it has made contributions to conservation in many areas especially exploring incentives for the sustainable hunting of bushmeat (Kümpel et al. 2009; Kümpel et al. 2010a; Kümpel et al. 2010b; Gill et al. 2012); and for alternative livelihoods to hunting (Allebone-Webb et al. 2011).

With research records dating back to 1990, the Bioko Biodiversity Protection Program is the only long term conservation organization operating in Equatorial Guinea. It is also unique because 1) it is an academic partnership rather than being an NGO or a free standing non-profit organization; and, 2) it is based in the United States although it works closely with its academic partner in Malabo, the National University of Equatorial Guinea.

The BBPP was founded by Gail Hearn in 1998 as an academic partnership between Arcadia University, where she was a Biology professor, and the National University of Equatorial Guinea. It was based on research begun in 1990 on the conservation status of Bioko's primates and expanded to sea turtle research in 2000. The character of the partnership was influenced by Arcadia University's expertise in undergraduate study abroad programs, and the success of initial attempts beginning in 1996 to bring university students

from the United States to study and research on Bioko Island. Another influence was the desire to engage local people in conservation efforts and that resulted in hiring forest patrols in 1997.

Two other factors shaped BBPP: Co-Director Wayne Morra, an economics professor at Arcadia, understood the importance of making biodiversity protection a profitable endeavor for local people, and all the Arcadia faculty involved in the early years of the program realized that ultimately the conservation research that would lead to the protection of Bioko's wildlife rested with the UNGE faculty and their development.

In 2007, BBPP ended its relationship with Arcadia University in a friendly manner and moved to Drexel University and the latter is the current institution with which UNGE maintains the partnership (BBPP, 2015). Being the protection and conservation of Bioko Island's biodiversity as its objective, BBPP utilizes different strategies to achieve its goals: 1) bushmeat market censuses since 1997; 2) a team of forest patrols that censuses wildlife in the Gran Caldera Scientific Reserve since 1998; 3) a team of turtle patrols that keeps a count of Bioko's nesting marine sea turtles since 1999; 4) an international study abroad program since 2002; 5) a research station (the Moka Wildlife Center) in the village of Moka since 2006 (Cronin et al. 2010).

BBPP contributes significantly to biodiversity conservation knowledge on Bioko Island and has produced tangible works in many aspects: primate conservation (Hearn et al. 2006; Butynski et al. 2009; Morra et al. 2009; Cronin et al. 2010; Cronin et al. 2013; Cronin et al. 2014; Cronin et al. 2015; Cronin et al. 2016) marine sea turtles conservation(Rader et al. 2006; Fitzgerald et al. 2011; Honarvar et al. 2011) and public awareness campaign materials (Rader, 2012; Jay, 2012) etc.

Two not-for-profit organizations based in the United States that are active on Bioko Island have BBPP alumni as their founders, although neither is active in the field of biodiversity conservation. The Ladybug Project, Inc. (LPI) was founded in 2010 by Kim Reuter, who was a volunteer in the Bioko Biodiversity Protection Program's 2010 Grand Caldera Expedition and later did three months of monkey census field work with the same program (The Ladybug Project 2015). The LPI operates on Bioko Island and its objective is to help foster educational and health infrastructure in Equatorial Guinea (The Ladybug Project 2015). The LPI supported important research in the fields of health and education in Equatorial Guinea (Naseef and Reuters 2013; Reuter et al., 2014). The Program is still ongoing in Equatorial Guinea. The Simply Equal Education/Books for Bioko Program was launched by two graduates from Arcadia University, Amanda Malamut and Caitlin McGee, after attending the Bioko Biodiversity Protection Program's Study Abroad component in 2008. The program's main sponsor is Marathon Oil Corporation and its purpose is to provide school supplies to schools in need in the city of Malabo, Bioko Island (Simply Equal Education 2015). For six years, Marathon Oil allocated more than $680,000 of funding for the Books for Bioko Program, benefiting over 5,100 school students by 2014 (Marathon Oil Corporation, 2015). The Program is still active in Equatorial Guinea.

Recently a new NGO, the EcoGuinea, has been established on Bioko Island with goals very similar to those long espoused by BBPP. This new project focuses on the wildlife of Pico Basile National Park, paralleling the focus of BBPP on the larger Southern Highlands and Gran Caldera Scientific Reserve. The goal of EcoGuinea is to create a research center, develop environmental education programs and interventions, improve forest management, and train UNGE students to work in forestry management. Sponsored by Marathon Oil,

PBCP works in partnership with the Instituto de Desarrollo Forestal y Areas Protegidas (INDEFOR-AP), the Universidad Nacional de Guinea Ecuatorial (UNGE) and the Asociación ECOTONO from Spain (Marathon Oil Corporation, 2015). The project is the conservation outcome of many years of research on local livelihoods and protein intake by John Fa and his students (Fa et al. 2002a; Vega et al. 2013; Vega et al. 2015).

Overview of Biodiversity Conservation Research on Bioko Island and in Rio Muni

Biodiversity conservation research began after Equatorial Guinea obtained its independence from Spain in 1968. Before then, relevant research was focused on the identification of species and determining the extent of their ranges. On Bioko, major contributions were made by the German biologist Eisentraut (1973) working on terrestrial vertebrates, by the Spanish Basilio (1963) working on birds, by the French biologist Heim de Balsac (1968) working on insectivorous mammals, and by the German biologist Mertens (1968) working on amphibians and reptiles.

During the Macias years (1968 through 1980) the country was closed to scientists and little was known of the status of wildlife. Bioko Island was of special concern because of the small size of the island and the possibility that either hunting or habitat destruction had eliminated or greatly reduced populations of the rare primates. As the country opened to foreigners in the early 1980's scientists returned, but the emphasis had shifted from finding new species to biodiversity conservation.

A special issue of the journal Biodiversity and Conservation in December 1994 published the invited papers presented at a workshop entitled "Biodiversity and Conservation of the Gulf of Guinea Islands" held at the Jersey Wildlife Preservation Trust. This workshop

summarized the conservation research being undertaken on Bioko Island and included important contributions by biologists from the Jersey Wildlife Preservation Trust in the United Kingdom (John Fa), from organizations associated with the Doñana National Park in Spain (Javier Castroviejo, Javier Juste B, Jaime Perez del Val, Ramon Castelo, Ramon Gil) and with the Atlanta Zoo in the United States (Tom Butynski). These research papers served as a foundation for conservation efforts that began in the 1990's, including those managed by Doñana, by BBPP/UNGE and others (Butynski & Koster 1994; Castroviejo et al. 1994; Juste & Fa 1994; Schaaf 1994; Fa et al. 1995)

The next gathering of conservation biologists with an interest in Bioko's wildlife took place in March 2002 in Malabo (Bioko Island) and was sponsored by Conservation International, the National University of Equatorial Guinea (UNGE) and the Bioko Biodiversity Protection Program (BBPP/Arcadia University). The goal of the "Bioko Biodiversity Roundtable" was to find solutions, with guidance from Conservation International, to the growing problems of wildlife conservation on the island. Scientists from academic institutions (Duke University and Arcadia University in the United States; the University of Alcala, the Royal Botanical Gardens and the Museum of Natural History in Spain; the Free University of Brussels in Belgium), and from conservation organizations (CI; Durrell Wildlife Conservation Trust, ECOFAC; CUREF) were joined by government officials from SNAP and the Ministry of Forests. The roundtable approved a document, "Malabo Declaration on the Preservation of Bioko Island Biodiversity," which identified organisms of special concern and called on the government of Equatorial Guinea to take action to prevent their extinction.

Conservation International (CI) hosted a 10-year follow-up to the Bioko Roundtable with meetings in Bata on the mainland and in Malabo on Bioko Island in 2012, just before ceasing its operations in Equatorial Guinea. Although attempts to reach agreement on a summary document were not successful, the roundtable did highlight the outreach projects undertaken to promote biodiversity conservation. In addition, CI played the role of implementing partner of the UNDP/GEF projects before its departure from Equatorial Guinea and many of those projects were never implemented what they had in common were the workshops. For example, two workshops were held in Bata: June 1 & 2, 2009; and, April 25 through 30, 2011.

TABLES FOR CHAPTER 1

Table 1.1. African countries with the greatest number of native primate species

Rank	Country	Area (km²)	# Primate Spp.
1	Democratic Republic of the Congo	2,345,000	34
2	Cameroon	475,000	31
3	Nigeria	924,000	26
4	Equatorial Guinea	28,000	23
5	Congo	342,000	22
6	Uganda	236,000	20
7	Central African Republic	623,000	20
8	Gabon	265,000	20
9	Tanzania	945,000	19
10	Angola	1,247,000	19

*Data extracted from (Oates, 1986)

Table.1.2: Primates of Equatorial Guinea (Bioko Island and Rio Muni), including those shared with Gabon and Cameroon.

Primate Taxon		Equatorial Guinea		Cameroon	Gabon	Red list category
Genus name	**Species name**	**Rio Muni**	**Bioko Island**			
Hominidae						
Gorilla	*Gorilla gorilla*	P*	NP**	P	P	Endangered
Pan	*Pan troglodytes*	P	NP	P	P	Endangered
Colobinae						
Colobus	*Colobus satanas*	P	P	P	P	Endangered
Procolobus	*Procolobus pennantii*	NP	P	NP	NP	Endangered
Cercopithecinae						
Cercopithecus	*Cercopithecus preussi*	NP	P	P	NP	Endangered
Lophocebus	*Lophocebus albigena*	P	NP	P	P	Least Concern
Cercocebus	*Cercocebus torquatus*	P	NP	P	P	Vulnerable
Moustached guenon	*Cercopithecus cephus*	P	NP	P	P	Least Concern
Cercopithecus	*Cercopithecus erythrotis*	NP	P	P	NP	Vulnerable
Cercopithecus	*Cercopithecus neglectus*	P	NP	P	P	Least Concern
Cercopithecus	*Cercopithecus nictitans*	P	P	P	P	Vulnerable
Cercopithecus	*Cercopithecus pogonias*	P	P	P	P	Vulnerable
Mandrillus	*Mandrillus leucophaeus*	NP	P	P	NP	Endangered
Mandrillus	*Mandrillus sphyinx*	P	NP	P	P	Vulnerable
Miopithecus	*Miopithecus ogouensis*	P	NP	P	P	Least Concern
Galagos						
Euoticus	*Euoticus elegantus*	P	NP	P	P	Least Concern
Euoticus	*Euoticus pallidus*	NP	P	P	NP	Endangered
Galagoides	*Galagoides demidovii*	P	P	P	P	Least Concern
Galagoides	*Galagoides thomasi*	P	P	P	P	Least Concern
Sciurocheirus	*Sciurocheirus alleni*	NP	P	P	NP	Least Concern
Sciurocheirus	*Sciurocheirus gabonesis*	P	NP	P	P	Least Concern
Lorisidae						
Arctocebus	*Arctocebus aureus*	P	NP	P	P	Vulnerable
Perodicticus	*Perodicticus edwardsi*	P	NP	P	P	Vulnerable

(IUCN 2016) *P*=present; NP**=no present*

Table 1.3: Comparison of mammals inhabiting Bioko Island with those inhabiting Mt. Cameroon during the latter half of the 20th century

BIOKO ISLAND MAMMALS [2]	**WESTERN CAMEROON MAMMALS**
INSECTIVORES (SHREWS)	**INSECTIVORES (SHREWS)**
	Giant otter shrew, *Potamogale velox*
Eisentraut's mouse shrew, *Myosorex eisentrauti*	
	Rumpi mouse shrew, *Myosorex rumpii*
	Morio climbing shrew, *Silvisorex morio*
	Grant's climbing shrew, *Silvisorex granti*
	Schouteden's rodent shrew, *Paracrociura schoutendeni*
Bioko white tooth shrew, *Crocidura poensis*	
Dolichura white tooth shrew, *Crocidura dolichura*	Dolichura white tooth shrew, *Crocidura dolichura*
	Dent's white tooth shrew, *Crocidura denti*
	Buettikofer's white tooth shrew, *Crocidura buettikoferi*
	Yellow-colored white tooth shrew, *Crocidura flavescens*
	Littoral white-tooth shrew, *Crocidura littoralis*
	Eisentraut's white tooth shrew, *Crocidura eisentrauti*
CHIROPTERA (BATS)	CHIROPTERA (BATS) (listing from Juste & Ibanez. 1994. Biodiversity & Conservation 9:837-850)
Straw-colored fruit bat, *Eidolon helvum*	Straw-colored fruit bat, *Eidolon helvum*
Egyptian fruit bat, *Rousettus aegyptiacus*	Egyptian fruit bat, *Rousettus aegyptiacus*
Angola fruit bat, *Lyssonycteris angolensis*	Angola fruit bat, *Lyssonycteris angolensis*
Collared fruit bat, *Myonycteris torquatus*	Collared fruit bat, *Myonycteris torquatus*
[1]Franquet's (singing) fruit bat, *Epomops franqueti*	Franquet's (singing) fruit bat, *Epomops franqueti*
Hammer bat, *Hypsignatus monstrosus*	Hammer bat, *Hypsignatus monstrosus*
Dwarf epauletted fruit bat, *Micropteropus pusillus*	Dwarf epauletted fruit bat, *Micropteropus pusillus*
	Flying calf, *Nanonycteris veldkampi*
	Tear-drop fruit bat, *Scotonycteris ophiodon*

BIOKO ISLAND MAMMALS [2]	WESTERN CAMEROON MAMMALS
Zenker's tear-drop fruit bat, *Scotonycteris zenkeri*	Zenker's tear-drop fruit bat, *Scotonycteris zenkeri*
Nectar bat, *Megaloglossus woermanni*	Nectar bat, *Megaloglossus woermanni*
Mauritian tomb bat, *Taphozous mauritianus*	Mauritian tomb bat, *Taphozous mauritianus*
	Black hawk bat, *Saccolaimus peli*
Slit-faced bat, *Nycteris arge*	Slit-faced bat, *Nycteris arge*
	Slit-faced bat, *Nycteris grandis*
Slit-faced bat, *Nycteris hispida*	Slit-faced bat, *Nycteris hispida*
	Slit-faced bat, *Nycteris intermedia*
	Slit-faced bat, *Nycteris major*
Horseshoe bat, *Rhinolophus alcyone*	Horseshoe bat, *Rhinolophus alcyone*
	Horseshoe bat, *Rhinolophus alticolus*
	Horseshoe bat, *Rhinolophus clivosus*
Lander's horseshoe bat, *Rhinolophus landeri*	Lander's horseshoe bat, *Rhinolophus landeri*
	Leaf-nose bat, *Hipposideros beatus*
	Cameroon leaf-nose bat, *Hipposideros camerunensis*
Commerson's leaf-nose bat, *Hipposideros commersoni*	Commerson's leaf-nose bat, *Hipposideros commersoni*
Cyclops leaf-nose bat, *Hipposideros cyclops*	Cyclops leaf-nose bat, *Hipposideros cyclops*
"Shortened" leaf-nose bat, *Hipposideros curtus*	
Red leaf-nose bat, *Hipposideros ruber*	Red leaf-nose bat, *Hipposideros ruber*
	Bocage's hairy bat, *Myotis bocagei*
Kuhl's pipistrelle, *Pipistrellis kuhlii*	
Really tiny? pipistrelle, *Pipistrellis nanulus*	Really tiny? pipistrelle, *Pipistrellis nanulus*
	Dwarf pipistrelle, *Pipistrellis nanus*
	Eisentraut's pipistrelle, *Pipistrellis eisentrauti*
Cape? pipistrelle, *Pipistrellis capensis*	Cape? pipistrelle, *Pipistrellis capensis*
Small-tailed? pipistrelle, *Pipistrellis tenuipennis*	Small-tailed? pipistrelle, *Pipistrellis tenuipennis*
Moloney's flat-headed bat, *Mimetillus moloneyi*	Moloney's flat-headed bat, *Mimetillus moloneyi*
	House bat, *Scotophilus nux*
Bioko butterfly bat, *Glauconycteris/Chalinolobus poensis*	
	Silver butterfly bat, *Glauconycteris/Chalinolobus argentata*

BIOKO ISLAND MAMMALS [2]	WESTERN CAMEROON MAMMALS
Beatrix butterfly bat, *Glauconycteris beatrix*	Beatrix butterfly bat, *Glauconycteris beatrix*
	Egeria butterfly bat, *Glauconycteris egeria*
	Schreiber's long-fingered bat, *Miniopterus schreibersi*
	Medallioned? woolly bat, *Kerivoula phalaena*
	Smith's woolly bat, *Kerivoula smithii*
Platyops serotine bat, *Eptesicus platyops*	
	Whitley's (winged rat) free-tailed bat, *Myopterus whitleyi*
	Wrinkle-lipped bat, *Chaerephon pumila*
	Mops free-tailed bat, *Mops (X.) nanulus*
	Mops free-tailed bat, *Mops (X.) petersoni*
Spurell's mops free-tailed bat, *Mops (X.) spurelli*	Spurrell's mops free-tailed bat, *Mops (X.) spurrelli*
Thersites mops free-tailed bat, *Mops (X.) thersites*	Thersites mops free-tailed bat, *Mops (X.) thersites*
PRIMATES: PROSIMIANS, MONKEYS & APES	**PRIMATES: PROSIMIANS, MONKEYS & APES**
	Calabar angwantibo, *Arctocebus calabarensis*
	Potto, *Perodicticus potto*
Pallid needle-clawed galago, *Euoticus pallidus*	Pallid needle-clawed galago, *Euoticus pallidus*
Allen's squirrel galago, *Galago alleni*	Allen's squirrel galago, *Galago alleni*
Demidoff's galago, *Galagoides demidoff*	Demidoff's galago, *Galagoides demidoff*
Thomas's galago, *Galagoides thomasi*	Thomas's galago, *Galagoides thomasi*
MONKEYS	MONKEYS
Drill, *Mandrillus leucophaeus*	Drill, *Mandrillus leucophaeus*
Black colobus, *Colobus satanas*	*(nearest mainland population south of the Sanaga River)*
Pennant's red colobus, *Procolobus pennant*i	*(recent DNA evidence indicates that closest relative is P. preussi, not the Niger Delta)*
	Preuss's red colobus, *Procolobus preussi*
	Red-capped mangabey, *Cercocebus torquatus*
	Gray-cheeked mangabey, *Lophocebus albigena*

BIOKO ISLAND MAMMALS [2]	WESTERN CAMEROON MAMMALS
Red-eared guenon, *Cercopithecus erythrotis*	Red-eared guenon, *Cercopithecus erythrotis*
Crowned guenon, *Cercopithecus pogonias*	Crowned guenon, *Cercopithecus pogonias*
Putty-nose guenon, *Cercopithecus nictitans*	Putty-nose guenon, *Cercopithecus nictitans*
Preuss's guenon, *Cercopithecus preussi*	Preuss's guenon, *Cercopithecus preussi*
	Mona monkey, *Cercopithecus mona*
APES	APES
	Chimpanzee, *Pan troglodytes*
	Gorilla, *Gorilla gorilla*
RODENTS: SQUIRRELS, ANOMALURES, PORCUPINES, RATS AND MICE.	**RODENTS: SQUIRRELS, ANOMALURES, PORCUPINES, RATS AND MICE.**
SQUIRRELS	SQUIRRELS
African pygmy squirrel, *Myosciurus pumilio*	African pygmy squirrel, *Myosciurus pumilio*
Red-cheeked rope squirrel, *Funisciurus leucogenys*	Red-cheeked rope squirrel, *Funisciurus leucogenys*
	Fire-footed rope squirrel, *Funisciurus pyrropus*
	Lady Burton's rope squirrel, *Funisciurus isabella*
	Cooper's mountain squirrel, *Paraxerus cooperi*
Green squirrel, *Paraxerus poensis*	Green squirrel, *Paraxerus poensis*
Red-legged sun squirrel, *Heliosciurus rufobrachium*	Red-legged sun squirrel, *Heliosciurus rufobrachium*
African giant squirrel, *Protoxerus stangeri*	African giant squirrel, *Protoxerus stangeri*
ANOMALURES (SCALY-TAILS)	ANOMALURES (SCALY-TAILS)
Lord Derby's anomalure, *Anomalurus derbianus*	Lord Derby's anomalure, *Anomalurus derbianus*
Beecroft's anomalure, *Anomalurus beecrofti*	Beecroft's anomalure, *Anomalurus beecrofti*
	Lesser anomalure, *Anomalurus pusillus*
	Zenker's flying mouse, *Idiurus zenkeri*
	Long-eared flying mouse, *Idiurus macrotis*
Cameroon scaly-tail, *Zenkerella insignis*	Cameroon scaly-tail, *Zenkerella insignis*
DOORMICE	DOORMICE

BIOKO ISLAND MAMMALS [2]	WESTERN CAMEROON MAMMALS
African dormouse, *Graphiurus crassicaudatus*	African dormouse, *Graphiurus crassicaudatus*
PORCUPINES	PORCUPINES
	Crested porcupine, *Hystrix cristata*
Brush-tailed porcupine, *Atherurus africanus*	Brush-tailed porcupine, *Atherurus africanus*
CANE-RATS	CANE-RATS
	Savannah cane-rat, *Thryonomys swinderianus*
	Marsh cane-rat, *Thryonomys gregorianus*
RAT-LIKE RODENTS	RAT-LIKE RODENTS
Hump-nosed mouse, *Hybomys univittatus*	Hump-nosed mouse, *Hybomys univittatus*
	Zebra mouse, *Lemniscomys striatus*
	Brush-furred mouse, *Lophuromys sikapusi*
Brush-furred mouse, *Lophuromys nudicaudus*	Brush-furred mouse, *Lophuromys nudicaudus*
	Multimammate rat, *Mastomys natalensis*
	Groove-toothed rat, *Otomys irroratus*
	Common mouse, *Mus setulosus*
	Rusty-nosed rat, *Oenomys hypoxanthus*
Long-footed rat, *Malacomys longipes*	Long-footed rat, *Malacomys longipes*
Broad-footed thicket rat, *Thamnomys rutilans*	Broad-footed thicket rat, *Thamnomys rutilans*
African wood mouse, *Hylomyscus aeta*	African wood mouse, *Hylomyscus aeta*
African wood mouse, *Hylomuscus alleni*	African wood mouse, *Hylomuscus alleni*
African wood mouse, *Hylomyscus stella*	African wood mouse, *Hylomyscus stella*
	Climbing mouse, *Dendromus mystacalis*
Soft-furred rat, *Praomys tullberi*	Soft-furred rat, *Praomys tullberi*
Soft-furred rat, *Praomys morio*	Soft-furred rat, *Praomys morio*
	Soft-furred rat, *Praomys jacksoni*
	Soft-furred rat, *Praomys hartwigi*
Target rat, *Stochomys longicaudatus*	Target rat, *Stochomys longicaudatus*
Link rat, *Deomys ferugineus*	Link rat, *Deomys ferugineus*
Giant pouched rat, *Crisetomys emini*	Giant pouched rat, *Crisetomys emini*
CARNIVORES	**CARNIVORES**
VIVERRIDS (CIVETS)	VIVERRIDS
	Blotched genet, *Genetta tigrina*
Linsang, *Poiana richardsoni*	Linsang, *Poiana richardsoni*
(extinct in 20th century?)	African palm civet, *Nandina binotata*

BIOKO ISLAND MAMMALS [2]	WESTERN CAMEROON MAMMALS
HERPESTIDS (MONGOOSES)	HERPESTIDS (MONGOOSES)
	Cusimanse, *Crossarchus obscurus*
	Black-legged mongoose, *Bdeogale negripes*
	Long-snouted mongoose, *Herpestes naso*
FELIDS (CATS)	FELIDS (CATS)
	Golden cat, *Felis aurata*
	Leopard, *Panthera pardus*
MUSTELIDS (OTTERS & WEASELS)	MUSTELIDS (OTTERS & WEASELS)
	Ratel (Honey badger), *Mellivora capensis (3)*
(extinct in 20th century?)	Swamp otter, *Aonyx congica*
PHOLIDOTA: SCALY ANT-EATERS	
	Long-tailed pangolin, *Uromanis tetradactyla(3)*
Tree pangolin, *Phataginus tricuspis*	Tree pangolin, *Phataginus tricuspis*
	Giant pangolin, *Smutsia gigantean(3)*
HYRAXES	**HYRAXES**
Tree hyrax, *Dendrohyrax dorsalis*	Tree hyrax, *Dendrohyrax dorsalis*
PROBOSCIDS (ELEPHANTS)	**PROBOSCIDS (ELEPHANTS)**
	Elephant, *Loxodonta africana*
ARTIODACTYLA (EVEN-TOED UNGULATES)	**ARTIODACTYLA (EVEN-TOED UNGULATES)**
---	Red river hog, *Potamochoerus porcus*
---	Giant hog, *Hylochoerus meinertzhageni* [3]
---	Water chevrotain, *Hyemoschus aquaticus*
(extinct in late 19th century?)	Forest buffalo, *Syncerus caffer*
	Bay duiker, *Cephalophus dorsalis*
Ogilby's duiker, *Cephalophus ogilbyi*	Ogilby's duiker, *Cephalophus ogilbyi*
Blue duiker, *Cephalophus monticola*	Blue duiker, *Cephalophus monticola*
	Yellow-backed duiker, *Cephalophus silvicultor*
	Peter's duiker, *Cephalophus callipygus*
	Bushbuck, *Tragelaphus scriptus*
	Sitatunga, *Tragelaphus spekei* [3]
	Dwarf antelope, *Neotragus batesi* [3]

(1) Kingdon specifically shows an *Epomops* from Bioko Island, but it isn't listed as a Bioko Island species by Juste & Ibanez, 1994.
(2) Bioko Island species shown in red have been sold in the Malabo market as bushmeat
(3) Species not mentioned in Eisentraut but range map in Kingdon appears to include Mt. Cameroon area.

Table 1.4: Monkey and turtle species from Bioko Island.

Vernacular name	Binomial name	Red list category (Species)	Red list category (Subspecies)
Bioko black colobus*	*Colobus satanas satanas*	Vulnerable	Endangered
Bioko red colobus*†	*Procolobus pennantii pennantii*	Critically Endangered	Endangered
Bioko drill*	*Mandrillus leucophaeus poensis*	Endangered	Endangered
Bioko Preuss's monkey*	*Allochrocebus preussi †† insularis*	Endangered	Endangered
Bioko red-eared monkey*	*Cercopithecus erythrotis erythrotis*	Vulnerable	Vulnerable
Crowned monkey	*Cercopithecus pogonias pogonias*	Least Concern	Vulnerable
Bioko putty-nosed monkey	*Cercopithecus nictitans martini*	Least Concern	Vulnerable
Sea turtle species			
Atlantic Green	*Chelonia mydas*	Endangered	N/A
Leatherback	*Dermochelys coriacea*	Vulnerable	N/A
Hawksbill	*Eretmochelys imbricata*	Critically Endangered	N/A
Olive Ridley	*Lepidochelys olivacea*	Vulnerable	N/A

* Recognized by Grubb et al. (2003) as subspecies endemic to Bioko. †Recognized by Groves (2007) as a species (Piliocolobus pennantii) endemic to Bioko. ††Allocated to the genus Allochrocebus following Grubb (2006). (IUCN 2016). N/A (not applicable).

FIGURES FOR CHAPTER 1

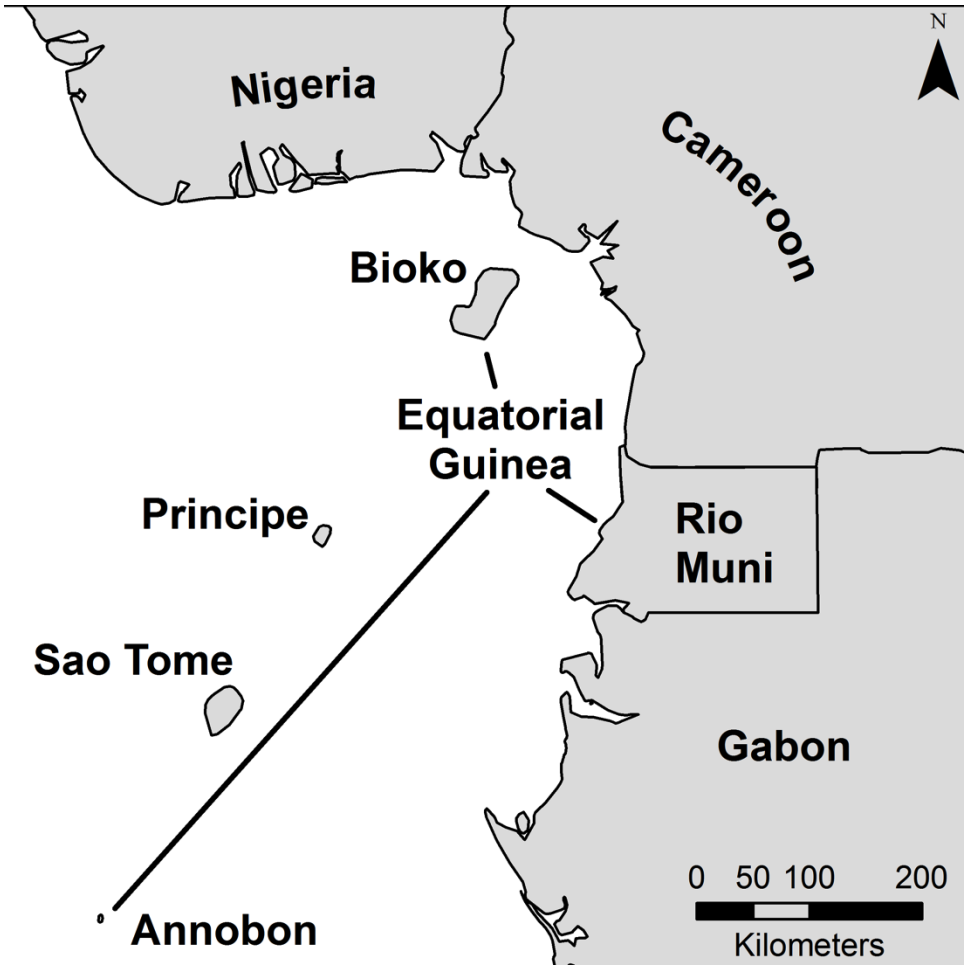


Figure 1.1: Gulf of Guinea region in central Africa showing the location of Equatorial Guinea (Rio Muni, Bioko, and Annobon) and its relationship with Nigeria, Cameroon and Gabon.

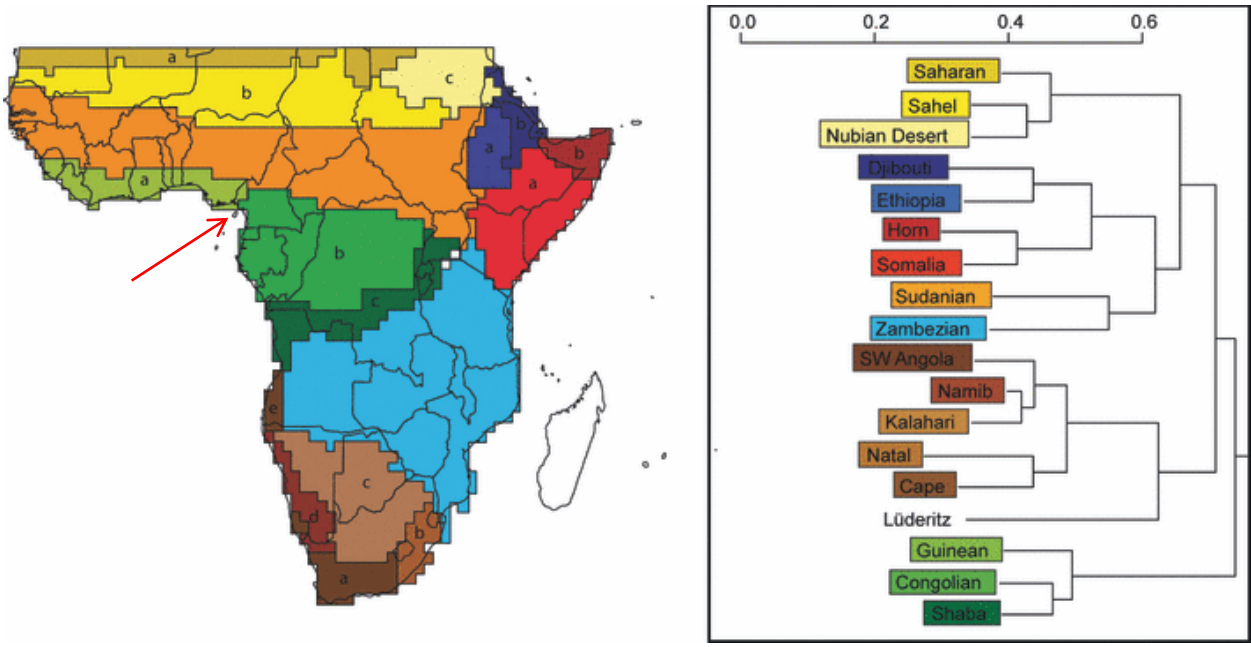


Figure 1.2: Major biogeographical regions of Sub-Saharan Africa, as defined statistically by Linder et al (2012). Bioko Island (red arrow) lies just to the west of the boundary between the Guinean and Congolian regions.

Chapter 2: Sociopolitical history and its relationship to in-country attempts to protect wildlife

A brief sociopolitical history of Equatorial Guinea

Introduction:

The Republic of Equatorial Guinea, 28,051 km², a West African country in the Gulf of Guinea, is composed of a continental territory Rio Muni, the Island of Bioko and the Island of Annobón, along with other small islands Corisco and the Elobeyes. The present capital of Malabo (100,000) is located on Bioko Island, but a new capital, Oyala, is currently being built in the eastern part of Rio Muni (Scafidi 2015) (Figure 2.1).

It is one of the smallest countries in Africa and has a population of 740,743 people with an annual growth rate of 2.5% (Central Intelligence Agency, 2016). Approximately 40% live in rural areas. In comparison to its neighboring countries (Gabon 63.1, Cameroon 55 and

Sao Tome and Principe 64.9), Equatorial Guinea (51.4) has the lowest life expectancy in the region (Africa Statistics yearbook 2014).

Although Equatorial Guinea has a GDP per capita of $33,300, 76.8 % of the population lives under the poverty line (The World Factbook 2016). Out of 187 countries, Equatorial Guinea has a human development index rank (.556) of 144 (Malik 2014). The ethnic groups represented in Equatorial Guinea in 1994: Fang 85.7%, Bubi 6.5%, Ndowe 3.6%, Annobon 1.6%, Bujeba 1.1%, other 1.4% (Central Intelligence Agency, 2016).

The native people of Equatorial Guinea

Five different ethnicities are found in Equatorial Guinea: the Pygmies, the Bubi, the Ndowe, the Fang, the Fernandinos, and the Annobonese (Liniger-Goumaz 1988).

The native people of the Gulf of Guinea region, which are broadly grouped into pygmy hunter-gatherers and Bantu-speaking farmers were derived from a common ancestor about 70,000 years ago (Quintana-Murci et al. 2008).

The Pygmy or hunter-gatherers were the first inhabitants of the African rainforests. They were to some extent displaced by the expansion of the Bantu-speaking farmers. However, the groups did interact and exchange cultural and technological knowledge (Vansina 1990b). Pygmy villages are still found in Rio Ntem region, where their old traditions of hunting and making fire technique remained unchanged into the late 1900's (Liniger-Goumaz 1988).

Bantu language studies suggest that the spread of the Bantu farmers took place in sub-Saharan Africa between 3000 BC and 500 AD. The Benue Valley in Nigeria is the original source of Bantu-speaking farmers. They divided into two groups about 3000 BC, with one of the groups, the West Bantu spreading eastward toward Cameroon (1560 BC) and beyond (1120 BC). Eventually West Bantu-derived languages spread throughout sub-Saharan Africa

(Vansina 1990a). Western Bantu farmers were sedentary, made pottery, planted root cops (yams) and cultivated oil palm and adopted metallurgy techniques (Vansina 1990b; Vansina 1995).

Linguistic studies suggest that one of the earliest branches of the Bantu expansion was the migration to Bioko Island, where they became, across successive waves of migration, the Bubi people. The Bubi culture was purely Neolithic given that they were the only Bantu group who did not mine, smelt, or use metals until nineteen century, but were excellent pottery makers (Vansina 1990b). Evidence of their pottery skills (pots, pot shards, and deep pit kilns) was unearthed at Punta Europa during the construction of what is now the Marathon Oil compound. Unfortunately, the pottery artifacts were not collected or preserved and are now presumed to have been accidentally destroyed as part of the construction.

When Mary Kingsley (1897) visited the island in the 1890's she reported that the Bubi people cultivated yams, taro, plantains, and oil palms. She also noted that the hunting of duikers, small monkeys, porcupines and squirrels, fishing and poaching of turtle eggs were very important activities for the Bubi people. At that time the Bubi people designed different kinds of tools (sharpened stones, basket traps, slings, knobkerries, barbed spears, traps and nets) that were used for hunting and fishing. The Bubi kept domesticated animals (cats, dogs, sheep, goats and poultry) (Kingsley 1897).

The Bubi people traded yams and palm oil with Africans and Europeans traders (like Mary Kingsley) and in return they were given iron that they used to make weapons (Vansina 1990b). They were notoriously effective at resisting enslavement during the 1700's but later cooperated successfully with various colonial rulers, first the British and later the Spanish.

The Ndowe people are another branch of the West Bantu expansion. They originated in the region of the Ubangi River in modern-day Cameroon and Central African Republic. They arrived in Rio Muni in the twelfth and thirteenth centuries and moved toward the coast in several waves of migration, becoming part of what is now referred to as Equatorial Guinea's "coastal tribes." The culture of the Ndowe was linked with the cultivation of plantains, cassava, yams and fishing. Different European powers employed the Ndowe as middlemen during the slave trade (Liniger-Goumaz 1988). From the late 1800's onward, the Ndowe continued interacting with outsiders as merchants and traders.

The Fang Bantu farmers also originated from the region of the Ubangi River in Central African Republic/Cameroon. They settled in Gabon, Cameroon and Rio Muni in the thirteenth century. The physical presence of Rio Benito serves as a dividing line between the two distinct linguistic groups (Fang Ntumu to the north and the Fang Okaka to the south) that exist in the Fang people.

The Fang Bantu farmers cultivated cassava, plantains, oil palm and were engaged in pastoralist activities (Liniger-Goumaz 1988). River fishing using traditional baskets was practiced by the Fang people (González Echegaray 1959). The Fang people were very skillful hunters and they originally used the cross-bow in hunting and later guns obtained from German merchants until the early twentieth century (Liniger-Goumaz 1988)

In Rio Muni, the Fang people were opposed to the slave trade and territorial occupation by Europeans; consequently, they inhabited the interior of the mainland resisting interaction with colonial governments and missionaries until well into the 1900's. The Fang people outnumbered the rest of ethnicities in Equatorial Guinea control the political situation of the country since Independence in 1968 (Liniger-Goumaz 1988).

The Fernandinos are a product of the British colonial period on Bioko Island. In 1827, Great Britain governed Bioko Island and used the island as a base for the Royal Navy, as well as a trading and anti-slaving center. They established Port Clarence (now Malabo) on the northern coast of the Bioko Island(Lynn 1984). The Fernandinos were Africans freed from slaving ships by the British Navy as well as British laborers imported from Sierra Leone who established themselves as a separate English-speaking (for lack of a common language) group in Port Clarence, complete with typical British names (Jones, Parker, etc.). The Fernandinos were involved in trading activities (yams, palm oil, spirits, livestock, tobacco and guns) and acted as middlemen between the Bubi people and the Europeans (Lynn 1984).

The Annobonese, inhabitants of the most distant and previously unpopulated Gulf of Guinea island of Annobon, were first brought to the island more than 500 years ago by the Portuguese as slaves to cut down timber (Holm 1989). They created a creole language called Fadambo. As might be expected of people living on a small oceanic island, they were excellent boatmen and fishermen (Holm 1989) .

European colonization and control of Equatorial Guinea:

The first record of explorers reaching the Gulf of Guinea from other parts of the world may well have been the voyage of Hanno the Navigator in the sixth or fifth century BC. He was a Carthaginian, best known for his exploration of the western coast of Africa. Although only fragmentary records remain, his mention of "rivers of fire" suggest the active volcano Mt. Cameroon, and his "island with a lake" could have been Bioko Island. His report of hairy human-like creatures could have been gorillas, or more likely, chimpanzees. In any case, although the Carthaginians traded good for gold along the West African coast,

there was no further contact with Mediterranean people until the late 1400's (Warmington, 1964).

Bioko Island was discovered by the Portuguese navigator Fernão do Pó in 1472 and named "Fermosa" (beautiful). The name was later changed to Fernando Po to honor the discoverer. During that same voyage he also discovered Annobon Island. The two islands were originally Portuguese territories, but the Portuguese made no attempts at colonization (Thomas 1999).

Under the Treaties of San Idelfonso (1777) and Del Pardo (1778), Bioko Island and Annobón, in addition to other territories on the Gulf of Guinea coast, were ceded to Spain in exchange of territories (Colonia Del Sacramento and Santa Catalina Island) in the south of Brazil(Liniger-Goumaz 2000). The total area of the African territories came to approximately 800,000 km² (Liniger-Goumaz 1988), many times larger than present-day Equatorial Guinea. These territories were demarcated again in the second half of the nineteenth century and at the beginning of the twentieth century. The former took place under the Treaty of Berlin (1885) during which Spain was granted 180,000 Km² and the latter was under the Treaty of Paris (1900) with which Spain regained control over the Islands of Corisco, Elobeyes and Rio Muni (formerly known as Guinea Continental Española), Bioko Island, Annobón, covering a total of 28,051 km² (Liniger-Goumaz 1988; Borikó 1989).

Although Equatorial Guinea was a Spanish colony from 1777 onward, the Spanish failed in their early attempts to colonize Bioko Island and ended up formally leasing it to Great Britain from 1827 to 1834 for trading purposes and for slave trade suppression (Fegley 1989). This

was also a period of extensive natural history exploration by the British, and many African species owe their scientific description to specimens brought back to London either from Bioko Island, or on British ships that stopped at Bioko Island. Although technically a Spanish colony, a fact that was re-asserted with a resumption of direct Spanish control in 1858, the British influence extended to the end of the 1800's with English continuing as the colonial language. British ships continued to use the port. For example, Mary Kingsley (1897) still referred to the city that is now the capital (Malabo) by its English name (Clarence) rather than its Spanish name (St. Isabel).

During the period of the nineteenth century when Bioko Island was under Great Britain's rule the palm oil trade was a very lucrative activity on the island, together with logging which was carried out by the West African Company (Lynn 1984). The latter activity might have caused some deforestation on the Bioko Island.

In 1858, the Spanish government appointed its first governor in charge of their territories in the Gulf of Guinea (Fegley 1989) and it marked the beginning of tobacco and sugar cane plantations on Bioko Island (Liniger-Goumaz 2000). Between 1858 and1868, for the first time Spain was encouraged by the Sociedad Economica de Barcelona to promote colonization in the Bight of Biafra and this unsuccessful attempt was carried out by Jesuits missionaries and by bringing prisoners from Spain and Cuba (Sundiata 1996).

In 1854, cocoa was introduced to Fernando Po from Sao Tome (Sundiata 1996). Across the next century, most of the land suitable for cacao plantations (sea level to 600 m asl) was cleared, except along the very rainy southern coast, removing almost all of the primary lowland rainforest from the island. The first large cocoa producers were the Fernandinos and a few Spanish (Sundiata 1996). Although the Spanish came to dominate

cocoa production, the Fernandino planter Maximiliano Jones was prominent in the twentieth century and is memorialized by a statue in the town of Luba. In 1926, the Spanish initiated the colonization of the interior of Rio Muni by establishing cacao plantations, a goal that was accomplished successfully by late 1940s (Fegley 1989)

Most of the citizens of Equatorial Guinea today are Catholic, the result of a very successful campaign begun in 1883 by Claritin Missionaries, funded by the Spanish government. Their most successful colonization model consisted of a combination of mission, male boarding school, cacao plantations, female boarding school, catholic marriages, catholic families and villages(Creus 2004). By late 1940s, the majority of the Bubi population (96%) were baptized, 86% married based on Catholic sacrament and 75% knew how to read and write (Sundiata 1996).

In 1904, the Patronato de Indigenas or Native Patronage organization was created with the initial aim of protecting the Bubi and it gave advantages to the Bubi in matters related to education and emancipation (Fegley 1989). In 1943, the colonial institute of secondary education was created on Bioko Island (Borikó 1989). In 1944, the Spanish government enacted a Land Act, which gave the Bubi the right to own over 4 hectares of land for the growing of export crops (Fegley 1989). Under the Spanish administration the children of emancipated (Bubi &Fernandino) natives were the only ones granted scholarships to study in Spain, a system that remained in place until 1960 (Borikó 1989)

The Spanish rule disenfranchised the Fang people in many ways: they were denied employment on Bioko Island and they were given very limited access to Spanish patronage and education (Fegley 1989). The last twenty years of Spanish rule were characterized by responses to criticisms of colonial control. In 1956, the name of the Spanish Territories in

the Gulf of Guinea was changed to Spanish province in the Gulf of Guinea by the Decree of August 21. In 1959, with the enactment of the Law of July 30, the region of Spanish Guinea was divided into two Spanish provinces: Fernando Po and Rio Muni (Borikó 1989).

In the late 1950s, several factors drove Equatorial Guinea toward independence: the pressures from the United Nations to European powers to promote self-determination of their African colonies; the intention of the general governor Francisco Ruiz to become the king of the Bubi (now the definitely more privileged ethnic group), and the discriminatory system imposed on the other ethnic groups, especially the Fang living in Rio Muni (Borikó 1989). The Spanish government responded in 1963, by ratifying the Law of November 9, granting an autonomous regime to Equatorial Guinea and creating two major entities, the General Assembly and the Government Council (Borikó 1989). However, the pressures for independence were overwhelming. On October 12, 1968 Equatorial Guinea was granted independence from Spain and elected as its first president Macias Nguema Biyogo, an ethnic Fang. When Spain granted Equatorial Guinea's independence, the entire country had 53 educated professionals, 85% of whom were educated during the autonomy period between 1964-68 (Borikó 1989)

Equatorial Guinea after independence from Spain

The regime of President Macias Nguema Biyogo was devastating to the country of Equatorial Guinea. The majority of intellectuals that Equatorial Guinea had at the time of its independence were executed, including the President of the first autonomous government Mr. Ondo Edu (Liniger-Goumaz 1988). Under President Macias's regime secondary schools and churches were closed and all Christian worship was banned(Liniger-Goumaz 1988). Approximately 8000 Spanish residents who owned most of the major businesses (cocoa

plantations, forestry concessions, oil palm and coffee plantations) departed. Approximately 24,000 Nigerian workers, who were critical to the operation of the cacao plantations, were forced to return to their home country (Liniger-Goumaz 1988). In 1976, the workforce shortage generated by the departure of the Nigerian laborers led President Macias's government to set up a domestic forced labor system by enacting a Presidential Decree that requested 2,500 people from each district to work in the plantations (Liniger-Goumaz 1988). Equatorial Guinea's economic situation sharply declined after five years under President Macias's rule: the per capita GNP was $170 in 1967 and it decreased to $70 by 1975(Liniger-Goumaz 1988). On August 3, 1979, Lt.-Col. Teodoro Obiang Nguema Mbasogo led a coup d'état that overthrew President Macias Nguema and then he became the second President of Equatorial Guinea since independence. Once President Obiang took over, churches and schools were reopened. On August 15, 1982, President Obiang passed a new constitution (Fegley 1989).

Cacao, especially Bioko Island cacao, was the economic backbone of the country before independence from Spain and the devastation by the Macias regime. In fact, Equatorial Guinea was known worldwide as the producer of the highest quality cocoa. In the 1980's some institutions such as the Organization of Petroleum Exporting Countries, the International Development Association and the Banque Arabe de Development de l'Afrique allocated funding towards the reestablishment of cocoa production (Liniger-Goumaz 1988). Chronic problems related to labor scarcity and the departure of experienced plantation owners had a significant impact on the quality and amounts of the cocoa produced. That impact continues to today: in 1989 cocoa production was 5,000 tonnes, a fraction of the pre-

independence amount (Liniger-Goumaz 1988) and by 2012, cocoa production was further reduced to only 881 tonnes (FAO 2015).

Timber production, another leading export before independence, was re-vitalized in 1982, when Italy provided Equatorial Guinea with a credit of $10 million to be invested in the construction of a timber processing plant based in the city of Bata on the mainland coast. However, timber production remained low and only 110,000 tonnes were produced in 1986, representing 32 % of the 1967 pre-independence amount (Liniger-Goumaz 1988). The slow economic recovery following the Macias regime left plantations abandoned and forests unlogged, creating hardship for the people of the country, but preserving and reclaiming natural habitat for wildlife (Butynski & Koster 1989b).

A period of petroleum-based economic recovery began in 1980, when Equatorial Guinea and Spain launched a national oil company named Guineo-Española de Petroleos, S.A. (GEPSA). The next year it detected the first signs of oil on the northern part of Bioko Island, followed by the discovery of a gas field, located 36 km. offshore to the north east of Malabo in 1984. However, by 1986 a decline in oil prices interrupted all petroleum projects in Equatorial Guinea (Liniger-Goumaz 1988).

In July 1990, an American Oil & Gas company known as Walter International drilled a successful gas well close to the previously discovery site and production started in December 1991 (Frynas 2004). In March 1995, oil was found by Mobil in its Zafiro field and production began in August of the following year. In 1999, while conducting oil prospection assessments off the coast of Rio Muni Triton, another US oil company, made the discovery of the Ceiba oil field. In 1996, Zafiro field began its production at 40,000 barrels/day (Frynas 2004) and nine years later it reached 400,000 barrels/day, placing

Equatorial Guinea as the fourth largest oil producer in Sub-Saharan Africa (World Bank, 2010).

Wildlife conservation by the government of Equatorial Guinea:

Legislation to protect wildlife and establish protected areas:

Equatorial Guinea, as an independent country created its first network of protected areas in the late 1980's, when the Law No8/1988 (Republic of Equatorial Guinea), regulating hunting, wildlife and protected areas (PA) was enacted. It contains 93 articles, including a hunting moratorium attached to it. Four major PA categories (national park, scientific reserve, and wildlife refuge and wildlife sanctuary) were created under article 16. Furthermore, each one of these categories is well-defined by articles 17, 18, 19 and 20. In the transitional provisions section, all nine PA's created by this legislation are listed (See Table 2.1), including the Grand Caldera Scientific Reserve (GCSR) which, under this law, has an area of 60,000 ha. However, none of the created PAs are assigned to their respective categories and they are only referred to as zones. Also, this legislation does not assign symbols (the equivalent of "flagship species") to any of its protected areas. This law was abolished by Law No7/2003.

One interesting early development reflected an increased openness on the part of the government, and an increased interest in attracting outsiders, especially potential tourists. Decree No42/1991, regulating photography and the free access to all places of touristic interest throughout the nation was passed. Although public knowledge of this decree was limited, its existence reassured scientists coming to Equatorial Guinea to document the status of wildlife.

More than a decade after the first attempt Law No4/2000 (Republic of Equatorial Guinea) on protected areas in Equatorial Guinea was enacted. It has fewer protected area categories (scientific reserve, national park, natural monument and natural reserve) than the previous law concerning protected areas. It also added four more PAs to the national system, adding up to a total of 13 (Table 2.2). In contrast to the previous law, this one pairs up each PA with its respective category and assigns a representative symbol. In regard to the GCSR, it's clearly designated as a scientific reserve for the first time. However, its area was reduced by 15% from its original size. The symbol assigned to the GCSR was an uninspiring (except perhaps to entomologists) dragonfly (*Trithemis hartwigi),* a data-deficient species (IUCN, 2016) known to be common on the mainland. This detail, namely the assignment of a relatively common insect to be the protected area symbol, rather than one of the endangered and charismatic monkey species endemic to the island, is indicative of the character of this legislation. As it happens, Law No4/2000 was soon replaced by another environmental regulation (Law No7/2003).

In 2003, Law No7/2003 (Republic of Equatorial Guinea) "Environmental Regulation in Equatorial Guinea" was enacted. It's composed of 163 articles and it establishes five protected area categories (natural parks, natural reserves, natural monument, protected landscapes and scientific reserves) in Article 21. Interestingly, all these categories are then well defined by articles 22, 23, 24 and 25; however, the category of "scientific reserve" is left out and does not have any specific definition. This has a direct impact on the GCSR, since "scientific reserve" is the category that was assigned to it under Law No4/2000. When it comes to protected areas, the environmental regulation is too generalized because it does not provide enough details about the existing protected areas. Its management and declaration of

future ones is assigned to the Ministry of Environment (article 30), including the development of wildlife catalogues (articles 37 and 38). In assisting with the implementation of the law, the Institute for Environmental Conservation (INCOMA) and the National Fund for the Environment (FONAMA) are created (article 155). This law abolishes all previous regulations on protected areas (law No8/1988 and law No4/2000), but it still acknowledges their existence and literally takes them on, which is clearly stated under the section of additional dispositions. This regulation is still in force.

A separate set of laws were enacted to regulate forest management in Equatorial Guinea. Just as the previous environmental protection laws assigned responsibility to the Ministry of Environment, these forest management laws assigned responsibility to the Ministry of Forests. This conflict produced confusion both within the country and internationally, especially with international donors (Table 2.3).

Law No1/1997(Republic of Equatorial Guinea), regulated the use and forest management in Equatorial Guinea. It addressed how the forest sector is regulated in the country by creating the Forest Development Institute (INDEFOR), a body under the Ministry of Forests, whose aim was to assure the development of a sustainable forest sector (Article 61). In 2002, the Decree No60/2002 (Republic of Equatorial Guinea) allocated INDEFOR the management of protected areas, becoming (INDEFOR-AP).

Curiously, the government has made progress in the international arena by adhering to important international conventions and agreements, for the protection of sea turtles on the African continent (*Agreement on the conservation of marine turtles of the Atlantic coast of Africa, 1999*) and at the international level (*Convention on migratory species of wildlife*); endangered species of wildlife (*Convention on the international trade of endangered species*

of wildlife, 1992); biodiversity protection (*Convention on biological diversity, 1994*); conservation of nature (*Convention on the international union for the conservation of nature, 1997* and the *African convention on the conservation of nature and natural resources, 2003*); climate change(*Kyoto protocol on climate change, 2000* and the *Convention on climate change, 2005)* (Table 2.3). The ministry of environment is the government entity signatory of these conventions, making it responsible for its implementation.

In conserving the country's wildlife, Equatorial Guinea has passed key biodiversity conservation decrees in many areas, such as protection of endangered species (Decree No 172/2005); protection of primates (Decree No 72/2007); biodiversity conservation (Decree No 171/2005) (Table 2.4). These decrees and strategies clearly stated that the Ministry of Environment was in charge of their implementation.

The question of responsible ministries resulted in two directions for biodiversity conservation in Equatorial Guinea. Bioko Island, the location of the capital of the country and the headquarters of the Ministry of Environment, focused on international agreements and the protection of endangered species. On the mainland, the location of the timber industry and to some extent, the Ministry of Forests, the emphasis fell on establishing and managing protected areas. The Ministry of Forests, in all its various iterations (Ministry of Forests and Agriculture, etc.), was known to be a "powerful" ministry with timber contract funding and was headed by one of President Obiang's sons; the Ministry of Environment, in all its various iterations (Ministry of Fisheries and Environment, etc.) was known to be a weak ministry with few sources of support and little political or economic power.

Protected areas did move slowly toward implementation on the mainland. At this time there exist copies of four management plan proposals: 1) management plan proposal for

the national park of Altos de Nsork and its surrounding area (NPAN), 2) management plan proposal for the Muni Estuary Natural Reserve and its surrounding area, 3) management plan proposal for the Rio Campo Natural Reserve and its surrounding area and 4) draft for the Monte Alen National Park.

Management Plan Proposal for the National Park of Altos de Nsork and its Surrounding area: In September 2008, the Asociación Amigos de la Naturaleza y del Desarrollo de Guinea Ecuatorial (ANDEGE) developed a management plan (MP) proposal for the National Park of Altos de Nsork (NPAN) and its surrounding area. Conservation International (CI) supported the project and provided technical assistance to it. The MP has five major parts: 1) introduction, 2) descriptive approach, 3) prospective approach, 4) operational approach; and 5) an appendix containing a map of the protected area. Important information about the type of wildlife that inhabits the NPAN is provided under part 2) descriptive information noting that the Okoume (*Aucoumea klaineana*) among its flora species and the *Mandrillus sphinx, Gorilla gorilla gorilla, Pantroglodytes* and the *Loxodonta africana-cyclotis* as part of its megafauna or large mammals.

Management Plan Proposal for the Muni Estuary Natural Reserve and its surrounding area: In August 2010, the local conservation initiative known as Amigos de la Naturaleza y del Desarrollo de Guinea Ecuatorial (ANDEGE), with funding from the International Union for Conservation of Nature (IUCN) and the Central Africa Regional Program for the Environment (CARPE), developed a

management plan (MP) proposal for the Muni Estuary Natural Reserve (MESNR) and its surrounding area. The MP comprises five major components: 1) introduction, 2) description of the reserve and its surrounding area, 3) management considerations, 4) management measures, management plan implementation; and 5) an appendix containing a map of the protected area. Based on the fauna information provided by the MP, some species of primates (*Mandrillus sphinx, Colobus satanas, Cercopithecus mona, Cercopithecus nictitans, Cercopithecus cephus*), wild pigs (*Potamochoerus porcus, Hylochoerus meinertzhageni*), carnivores (*Genetta maculata, Genetta servalina, Nadinia binotata, Atilax paludinosus*), Elephants (*Loxodonta africana cyclotis*) ,and bovines (*Syncerus caffer, Neutragus batesi, Cephalophus dorsalis*) can all be found in the MESNR.

Management Plan Proposal for the Rio Campo Natural Reserve and its Surrounding area: In August 2009, the Asociación Amigos de la Naturaleza y Del Desarrollo de Guinea Ecuatorial (ANDEGE), with a grant from the Central African Protected Areas Network (RAPAC), elaborated a management plan proposal for the Rio Campo Natural Reserve (RCNR) and its surrounding area: 1) Introduction; 2) description of the reserve and its surrounding area; 3) management considerations, 4) management measures, 5) management plan 6) a map attached to the appendix section. The second component highlights the composition of RCNR's biodiversity which is characterized by primate species (*Gorilla gorilla, Pan troglodytes, Colobus satanas, Cercocebus torquatus, Cercocebus albigena, Mandrillus sphinx, Cercopithecus cephus, Cercopithecus nictitans*), elephants (*Loxodonta africana cyclotis*), wild pig

(*Potamochoerus porcus*), duiker species (*Cephalophus monticola, C. dorsalis, C. sylvicultor, Neotragus batesi*), leopards (*Pantera pardus*), including the nesting of three sea turtle species (*Chelonya mydas, Eretmochelys imbricada* and *Dermochelys coriacea*).

Monte Alen National Park Management Plan: A management plan draft for the Monte Alen National Park, located in the mainland of Equatorial Guinea, was designed. The MP is composed of eight sections: 1) unique value of Monte Alen National Park, 2) characteristics of the PA, 3) desired conditions, 4) objectives, 5) guidelines, 6) micro-zones, 7) implementation schedule and 8) monitoring. The analysis of its sections exposed certain technical gaps, which, if they were taken into consideration, would help in enhancing the efficiency of the whole document once it is implemented. For instance, the first section provides general information on the flora and fauna and it makes references to maps not attached into the document; the second section lacks geomorphological information, such as Monte Alen's elevation.

Upon analyzing the three management plan proposals (Reserva Natural del Estuario del Rio Muni, Reserva Natural de Rio Campo and Parque Nacional de los Altos de Nsork), it was noticed that most of the aspects [for example: background information, biodiversity conservation focal objects, legislative and institutional frameworks, socioeconomic situation, cultural, short term and long run objectives, activities and assessment mechanisms (Herrera Fernandez et al, 2013)] necessary to develop management plans were taken into account. Despite not being sure of the qualifications of ANDEGE's team of scientists who conducted

some of the preliminary studies on socioeconomics (ANDEGE, 2008a; Mba Madja, 1999); fauna and flora (Mbomio Ngomo, 2006; Beca Ela, 1998) conservation of sea turtles (Mba Mba 1998); awareness campaigns (ANDEGE, 2008b), but their efforts and determination must be valued greatly. To date, it has been over seven years since the design of some of these management plan proposals and they are yet to receive the appropriate ministerial approval, without which it will be impossible to assess their efficiency in practice.

Management plans for the two protected areas on Bioko Island were delayed. However, on June 11-12, 2015, the Bioko Biodiversity Protection Program (BBPP) organized a symposium on the future of the Gran Caldera Scientific Reserve (GCSR) in Malabo, Bioko Island. The Government of Equatorial Guinea, ExxonMobil, the U.S. Embassy Malabo, Marathon Oil, Noble Energy and the United Nations Development Program/Global Environment Facility supported the event. It was attended by scientists, civil society members, policy makers, educators, NGOs and government ministries. The symposium's objectives were: 1) creation of a detailed framework for a GCSR management plan, 2) development of a strategy to classify the legal bases of GCSR protection, as well as the roles of the entities in charge of protected area management, 3) submission of an application to upgrade the GCSR to a UNESCO World Heritage Site.

Comparing legislation and protected area creation with Cameroon:

At the time of its independence in 1960, Cameroon inherited a total of ten protected areas [4 in the Far North Province: Waza National Park (170.000ha), Kalamaloue National Park (4500ha), Mozogo-Gokoro National Park (1400ha), Kalfou Wildlife Park(4.000ha); 3 in the North Province: Benue National Park (180.000ha), Faro National Park (330.000ha), Bouba-Ndjida National Park(220.000 ha); 1 in the East Province: Dja Reserve(526.000ha);1

in the Littoral Province: Douala Edea Wildlife Reserve (160.000ha);1 in the South Province: Campo Wildlife Park (271.000ha)]created under the colonial administration (Tchindjang et al. 2003). In 2015, the IUCN officially acknowledged the existence of 26 protected areas for Cameroon, of which 17 are national parks, 6 wildlife reserves, 2 gorilla sanctuaries and 1 sanctuary (Table2.5) *(Mertens et al. 2008).*

A basic analysis of wildlife regulations from Equatorial Guinea [(Law No8/1988, regulating wildlife protected areas and hunting; Law No7/2003, environmental regulations)] and Cameroon (Law No94/01, regulating forestry wildlife and fisheries) exposed certain differences: the regulations from Equatorial Guinea lack implementing regulations and moratoriums; however, the regulation from Cameroon have implementing regulations (Decree No95-466 of July 20, 1995) and two moratoriums (Order No0648 and Order No0649) in place (Table 2.6).

Unlike in Equatorial Guinea, where the Ministry of Environment is responsible of implementing most of the conventions ratified by the government, the government of Cameroon has a different approach based on sharing of responsibilities between its two major departments (the ministry of forests and wildlife and the ministry of environment, nature protection and sustainable development) in charge of environmental related matters: the former is responsible of implementing the *convention on migratory species of wildlife, convention on the protection of marine turtles of the Atlantic coast of Africa* and *the convention on the international trade of endangered species;* and the latter is in charge of *the Ramsar convention on wetlands of international importance, convention on biological diversity, Kyoto protocol on climate change* and *the convention on climate change* (Table 2.7).

Equatoguinean organizations in support of biodiversity conservation:

For biodiversity conservation to actually happen, there need to be organizations within the country to assist with implementation. These organizations must exist and they must have the logistical and human capacity to complete tasks assigned to them. Typically these organizations operate for good causes are registered with their governments as non-profit organizations (NPOs). Universities, churches, and biodiversity conservation organizations like Conservation International and Wildlife Conservation Society are all NPO's and they raise money from a variety of sources to support their missions. A non-governmental organization (NGO) is a special kind of NPO, existing primarily to spend money raised by the government. They exist to carry out governmental projects, but separate from the government itself.

Equatorial Guinea has very few independent organizations with a mission of biodiversity conservation. The government has a reputation for declining engagement with many international NGO's and NPO's. Both Conservation International (CI) and the Global Fund for Environment have been stymied in their attempts to extend their mission to Equatorial Guinea. Other governments, offering various types of assistance, have also been turned away. However, Equatoguinean organizations that can assist in biodiversity conservation are beginning to emerge.

The College of Environmental Sciences at the National University of Equatorial Guinea (UNGE), located on the main campus in Malabo, is beginning to do research and provide undergraduate training that will build the infrastructure for future conservation activities. In 2003, UNGE launched the Facultad de Medioambiente (*Faculty of Environment*), but its official proclamation did not take place until two years later when the Decree No148/2005 (Republic of Equatorial Guinea 2005) was enacted. Over the years, the

number of enrolments has been increasing; 31 students, for 2005/2006 academic year and 471 students, for 2014/2015 academic year and the Faculty of Environment has graduated a total of 67 students over the years (Tables 2.8 & 2.9) (F. Anda Esono, *personal communication,* July 11, 2015).

Two other home-grown conservation organizations exist in Equatorial Guinea. One concerns the protection of sea turtles nesting on the coast of Rio Muni. The other exists to design management plans for protected areas. Both are closely associated with the Ministry of Forest's Institute of Forest Development and Protected Areas (INDEFOR-AP).

Tortugas Marinas de Guinea Ecuatorial (TOMAGE) is an NGO that operates under the governmental agency INDEFOR-AP (INDEFOR-AP, 2014). The project was launched in 2002 (R. Esono, *personal communication,* July 20, 2015)**.** TOMAGE's main focus is the conservation of four sea turtles species that nest on the coastal beaches of the mainland and most of their activities (tagging and nest preparation) take place in three sites: Tica, Punta Llende and Playa Nendji (INDEFOR-AP, 2014). TOMAGE and BBPP are currently trying to open a new window of collaboration by the implementation of joint exercises and workshops. It appears that BBPP and INDEFOR-AP would like to strengthen their relationship with the signing of a memorandum of understanding in the near future (Mary Katherine Gonder, PhD., *personal communication*, May 31, 2016).

Amigos de la Naturaleza de Guinea Ecuatorial (ANDEGE) is the second NGO with close ties to INDEFOR-AP. It received its official recognition from the government of Equatorial Guinea in 2007 and is based in Bata on the mainland (*Amigos de la Naturaleza de Guinea Ecuatorial* 2008). To date, ANDEGE's most significant accomplishments are the

designs of the management plans of two main protected areas (Altos de Nsork and Rio Campo) in the mainland (*Amigos de la Naturaleza de Guinea Ecuatorial* 2008)

Discussion and recommendations:

Equatorial Guinea's unique sociopolitical history makes biodiversity conservation especially difficult. As the only Spanish-speaking country in sub-Saharan Africa, it had less interaction with its neighbors than other West African countries. Also, the fact that English is increasingly the language of commerce and research, it has been denied access to information. The Spanish government apparently had less interest in biodiversity conservation than others, as shown by the more advanced system of laws and protected areas left by European colonial powers to Cameroon. The Spanish government had created a political system that gave more privileges to the native Bubi people on Bioko Island than to the far more numerous Fang people in the interior of Rio Muni. Therefore it was inevitable that any ruler chosen by popular election would be from the Fang ethnic group, and would be suspicious of Bioko Island people. Unfortunately, Bioko Island has most of the country's unique biodiversity.

Following independence, Equatorial Guinea's first elected president, Macias, killed or exiled the educated citizens who could have provided the leadership for conservation. Even today, the country has only one university, and even that institution does not meet international standards: neither its courses nor its degrees are recognized by other universities. To our knowledge, there are only two people in the entire country who have doctorates in a scientific discipline, and only one of them, a Spanish-trained botanist, is a faculty-member at UNGE. However, the Macias government may have coincidentally reversed some of the development and habitat damage created during the Spanish colonial period.

Since President Obiang succeeded Macias, several additional factors have hindered the development of successful biodiversity conservation: 1) the Fang government has been reluctant to provide even indirect benefits to the previously favored Bubi people, but most biodiversity lies on Bioko Island, the Bubi homeland; 2) the oil-rich government has been reluctant to accept any help from outside, so that many conservation initiatives are refused or diluted; and 3) a culture of corruption has taken hold, especially in the last 20 years, so that the high cost of the country plus the high cost of corruption has discouraged outside aid.

To overcome barriers to successful biodiversity conservation, Equatorial Guinea needs to embark on a program that will train more competent local people and needs to take advantage of opportunities to learn from neighboring countries that face similar problems. These educated citizens can draft coherent, practical laws to protect wildlife and can become the government officials who are able to enforce those laws.

TABLES TO ACCOMPANY CHAPTER 2

Table 2.1: Protected areas created by Law No8/1988 as enacted by the government of Equatorial Guinea including overall size of each protected area.

	Name of Protected Area	**Area**	**Region**
1.	Zona del Sur de la Isla de Bioko	60.000 ha	Bioko Island
2.	Pico Basile o de Malabo	15.000 ha	Bioko Island
3.	Estuario del Rio Campo o Ntem	20 ha	Mainland
4.	Estuario del Rio Muni	70.000 ha	Mainland
5.	Macizo de los Montes Mitra	30.000 ha	Mainland
6.	Monte Alen	80.000 ha	Mainland
7.	Altos de Nsork	40.000 ha	Mainland
8.	Isla de Annobón	17.000 ha	Annobón
9.	Área de Ndote	N/A	Mainland

Table 2.2: Protected Areas created under Law No4/2000 (Republic of Equatorial Guinea)

Protected Area	Extension	Management Plan	Region
Gran Caldera de Luba Scientific Reserve	51.000 ha	In process	Bioko Island
Playa Nendyi Scientific Reserve	500 ha	None	Mainland
Pico Basile National Park	33.000 ha	None	Bioko Island
Monte Alen National Park	200.000 ha	Drafted	Mainland
Altos de Nsork National Park	70.000 ha	Proposed	Mainland
Piedra Bere National Monument	20.000 ha	None	Mainland
Piedra Nzas Natural Monument	19.000 ha	None	Mainland
Rio Campo Natural Reserve	33.000 ha	Proposed	Mainland
Monte Temelon Natural Reserve	23.000 ha	None	Mainland
Punta Llende Natural Reserve	5.500 ha	None	Mainland
Muni Estuary Natural Reserve	60.000 ha	Proposed	Mainland
Corisco and Elobeyes Natural Reserve	53.000 ha	None	Corisco & Elobeyes Islands
Annobón Natural Reserve	23.000 ha	None	Annobón Island

Table 2.3: Some important international conventions ratified by the government of Equatorial Guinea

Name and year	Department responsible	
	Ministry of Environment	**INDEFOR-AP**
Convention on migratory species of wildlife, 2009	Ministry of Environment	x
Ramsar convention on wetlands of international importance, 1997	Ministry of Environment	x
International Union for Conservation of Nature, 1997	Ministry of Environment	x
Convention on Biological Diversity, 1994	Ministry of Environment	x
Marine Turtles of the Atlantic Coast of Africa, 1999	Ministry of Environment	x
African Convention on the Conservation of Nature and Natural Resources, 2003	Ministry of Environment	x
Convention on the International Trade of Endangered Species, 1992	Ministry of Environment	x
Kyoto Protocol on Climate Change, 2000	Ministry of Environment	x
CMS Gorilla Agreement Action Plan, 2009	Ministry of Environment	x
Convention of Migratory Species of Water birds between Africa and Eurasia, 1997	Ministry of Environment	x
Convention on Climate Change, 2005	Ministry of Environment	x
Central Africa Forest Commission (COMIFAC), 2005	Ministry of Environment	x

Table 2.4: Some important national conservation decrees and strategies signed by the government of Equatorial Guinea

Name and year	Department responsible	
	Ministry of Environment	**INDEFOR-AP**
Decree No 171/2005 Strategies and Biodiversity Conservation Action Plan	Ministry of Environment	x
Decree No172/2005 Regulating the Trade of Endangered Species of Wildlife in Equatorial Guinea	Ministry of Environment	x
Decree No72/2007 Prohibiting Hunting and Consumption of Primates in Equatorial Guinea	Ministry of Environment	x
National Environmental Strategies 2010-20	Ministry of Environment	x
Decree No60/2002 (Republic of Equatorial Guinea), allocating INDEFOR the management of protected areas	x	INDEFOR-AP

Table2.5: List of protected areas from Cameroon recognized by the IUCN (*Protected Planet, 2014*)

IUCN Category II	Management Plan	IUCN Category IV	Management Plan
Korup National Park	Approved*	Dja Wildlife Reserve	Approved*
Vallée du Mbere National Park	None	Boumba Bek Wildlife Reserve	None
Faro National Park	None	Mengame Gorilla Sanctuary	None
Takamanda National Park	None	Banyang Mbo Sanctuary	None
Mbamet Djerem National Park	None	Douala Edéa Wildlife Reserve	None
Waza National Park	Approved*	Kagwene Gorilla Sanctuary	None
Mozogo Gokoro National Park	None	Santchou Wildlife Reserve	None
Campo Ma'an National Park	Approved*	Lac Ossa Wildlife Reserve	None
Bakossi National Park	None	None	None
Mont Cameroon National Park	None	None	None
Mpem et Djim National Park	None	None	None
Kalamaloue National Park	None	None	None
Nki National Park	None	None	None
Lobeke National Park	Approved*	None	None
Boumba Bek National Park	None	None	None
Bénoué National Park	Approved*	None	None

*Information on Cameroon's management plans was extracted from *Interactive Forestry Atlas of Cameroon (Version 2.0): An Overview* (Martens et al, 2007).

Table 2.6: Comparing two environmental policies from Equatorial Guinea to a similar one from Cameroon

Comparing wildlife regulations from Equatorial Guinea and Cameroon		
Law ***No 8/1988 (December 31)***Regulating wildlife, hunting and protected areas in Equatorial Guinea	Law ***No 7/2003(November 27)*** Environmental Act in Equatorial Guinea	Law ***No 94/01 (January 20, 1994),*** regulating Forestry, Wildlife and Fisheries in Cameroon
9 Protected Areas	13 Protected Areas	• IUCN Designations ○ 17 National Parks ○ 6 Wildlife Reserves ○ 2 Gorilla Sanctuaries ○ 1 Sanctuary (*Protected Planet, 2014*)
No implementing regulations	No implementing regulations 3 Management plan proposals and 1 draft	Decree No95-466 of July 20, 1995,Implementing regulations 6 Approved Management Plans (Martens et al, 2007)
PAs Categories (all defined): National Park, Scientific Reserve, Wildlife Refuge and Wildlife Sanctuary	PAs Categories: National Park, Nature Reserves, Natural Monuments, Protected Landscapes, Scientific Reserve (not defined)	PAs Categories (partially defined) : National park, Game and wildlife reserve, Forest reserve, Wildlife sanctuaries, Zoological gardens
Fines ($20~$400)	Fines ($10~$400,000)	Fines ($10-$20,000)
Moratorium attached	No moratorium	• Order No.0648 of December 18, 2006, listing animals of classes (A, B and C) • Order No.0649 of December 18, 2006, listing animals whose killing is authorized
Current Status: abolished	Current Status: into force	Current Status: into force

Table 2.7: Some important environmental conventions ratified by the government of Cameroon.

Conventions	**Department responsible**	
	Ministry of Forests and Wildlife (MFW)	**Ministry of Environment, Nature Protection and Sustainable Development (MENPSD)**
Convention on migratory species of wildlife, 1983	MFW	-----
Marine turtles of the Atlantic coast of Africa, 2002	MFW	-----
Convention on the international trade of endangered species, 1981	MFW	-----
Ramsar convention on wetlands of international importance, 2006	-----	MENPSD
Convention on Biological Diversity, 1995	-----	MENPSD
Kyoto protocol on climate change, 2002	-----	MENPSD
Convention on climate change, 1994	-----	MENPSD

Table 2.8: Enrollment at the Department of Environmental Sciences at the National University of Equatorial Guinea

Academic Year	Number of Students
Year 2005/2006	31
Year 2006/2007	63
Year 2007/2008	64
Year 2008/2009	79
Year 2009/2010	116
Year 2010/2011	144
Year 2011/2012	247
Year 2012/2013	234
Year 2013/2014	295
Year 2014/2015	475
Total	**1742**

**Source* (F. Anda Esono, *personal commun66ication*, July 11, 2015).

Table 2.9: Number of students graduated from the Department of Environmental Sciences at the National University of Equatorial Guinea

Academic year	Graduations	Percentage
Year 2006	19	28.3
Year 2007	4	6
Year 2008	0	0
Year 2009	2	3
Year 2010	4	6
Year 2011	0	0
Year 2012	15	22.3
Year 2013	6	9
Year 2014	13	19.4
Year 2015	4	6
Total	67	

**Source* (F. Anda Esono, *personal communication*, July 11, 2015).

Chapter 3: Determinants of bushmeat consumption among inhabitants of Bioko Island

Introduction

Bushmeat hunting (the killing of forest wildlife for human consumption) is endangering wildlife, especially in Africa (Newing 2001; Fa et al. 2002b). At one time this practice was essential for human survival because wild animals provided a necessary source of protein(Bennett 1899), and in many remote areas indigenous people still rely on bushmeat (Carpaneto & Fusari 2000; Fa et al. 2003). However, bushmeat hunting is increasingly a commercial enterprise and bushmeat is sold in big cities as a luxury item (Barnes 2002; Cronin et al. 2015). However, it's difficult to separate the commercial enterprise from the subsistence necessity because the hunters can either be professionals who hunt for a living (clearly more commercial) or farmers who hunt "part time" to feed their family and to supplement family income (clearly less commercial) (Fa et al. 2003; Kümpel et al. 2010a). This interaction and its effects on wildlife populations has been studied (Fa et al. 2002b; Corlett 2007; Nasi et al. 2011). Decreasing the demand for bushmeat (Barnes 2002; Oates et al. 2004; Abernethy et al. 2013), especially where alternative (often even cheaper) protein is available, is an important part of any conservation effort (Wilkie & Carpenter 1999; Peres et al. 2006; Parry et al. 2009; Wilkie et al. 2011; Abernethy et al. 2013). Decreasing demand is also important in preventing zoonotic diseases in humans such as Ebola, and AIDS (Wolfe et al. 2005).

The most basic approach to saving endangered populations of wildlife is to create protected areas (national parks and forest reserves) with clear boundaries and then forbid hunting within those boundaries. However, bushmeat hunting is a very complex issue that cannot be solved simply by walling off protected areas and banning hunting and so other

strategies are often employed (Pyhälä et al. , 2016). For example, decreasing the supply of bushmeat by creating laws forbidding the hunting and selling of bushmeat, especially meat from endangered species or species whose consumption can spread disease to humans (Rivalan et al. 2007; Biggs et al. 2013; Cronin et al. 2015). Alternatively, another strategy is decreasing the demand for bushmeat by punishing the buyers (fines) or raising the prices of bushmeat so high that people are forced to choose cheaper protein sources (Wilkie et al. 2005). However, the final solution is to change the eating habits of people, so they no longer desire bushmeat (Loibooki et al. 2002; Wilkie 2006).

It is now obvious that preventing the extinction of many of Africa's larger forest mammals will not be easy and complex individualized solutions will be required. However, it is impossible to appropriately plan for interventions and conservation without knowing what the socioeconomic factors driving consumption are. To learn more, public opinion surveys have been used to understand the demand for bushmeat and to provide clues for how the demand might be made less (Fa et al. 2002a; Brashares et al. 2004; Wilkie et al. 2005; Brashares et al. 2011; Carvalho et al. 2015).

The recent benchmark study by Brashares et al. (2011) was a survey of 2000 households in 4 African countries (Ghana, Cameroon, Tanzania and Madagascar) that focused on the economic and geographic drivers of wildlife consumption in rural Africa. They found that richer households in more urban settlements and poorer households in more rural settlements tended to be the ones who ate more bushmeat. Therefore, simply raising the standard of living would not eliminate the demand for bushmeat. More recently, Schulte-Herbrüggen et al. (2013) conducted a study of 63 households (787 participants) in Ghana to

assess the importance of bushmeat in the livelihoods of West African cash-crop farmers living in places where little wildlife remained to be harvested. They found an increase in bushmeat hunting and sales during the agricultural lean season.

Similar studies have been conducted closer to Equatorial Guinea. Wilkie et al. (2005) carried out a survey of 1208 rural and urban households in Gabon to better understand the role of prices and wealth in consumer demand for bushmeat. They revealed that bushmeat and fish may be reciprocal dietary substitutes. Schenck et al. (2006) completed 227 surveys in 2 urban areas and 1 rural area in Gabon using a two-choice taste test to clarify why people eat bushmeat. Their taste test revealed that consumers may be able to differentiate amongst bushmeat species.

Public opinion surveys about bushmeat have also been conducted in Rio Muni, the mainland part of Equatorial Guinea. East et al. (2005) surveyed 100 households from 11 districts (847 participants) in Rio Muni to understand the determinants of urban bushmeat consumption. Their findings showed that bushmeat consumption is greater among subjects from the Fang ethnic group than Ndowe. At about the same time, Fa et al. (2009) surveyed 569 households from six study sites in Rio Muni to understand the linkages between household wealth, bushmeat and other animal protein consumption. They reported high bushmeat prices and consumption among wealthier respondents in city areas.

Bioko Island has also been the site of surveys to determine patterns of bushmeat preference and consumption. Two studies explored the influence of ethnicity (Fang & Bubi). Fa et al. (2002) questioned 196 respondents from urban and rural areas on Bioko Island in 1990 and found a difference in bushmeat species preference, but not in bushmeat

consumption between the two groups. In a later study the same group of researchers (Vega et al. 2013) used a questionnaire and compared bushmeat consumption patterns in two rural villages, one Fang and the other Bubi, where bushmeat consumption was an important component of diet.

Strategies aimed at decreasing the hunting and eating of bushmeat have had limited success, both on Bioko Island and elsewhere (Oates 1999; Robinson & Bennett 2002; Cronin et al. 2015). Public awareness and opinion about these strategies which included laws, fines and other punishments, were usually not solicited as part of the surveys on bushmeat preferences. In fact, public perceptions of the many more benign outreach attempts by conservation organizations that have been made to discourage bushmeat consumption have also not been widely explored. There is evidence in the general literature that conservation outreach programs can be effective and can lead to behavioral changes (Hungerford & Volk 1990; Farmer et al. 2007). A survey of almost 850 high school adolescents (14-18 years old) from three large cities in the western United States reveled that favorable attitudes towards the environment can significantly predict later pro-environmental behaviors (Meinhold & Malkus 2005). However, an important study in Africa is less encouraging. Kuhar et al. (2010) used 6,388 surveys to assess the long-term impact of an environmental education program at a forest reserve in Uganda. Their findings revealed the importance of environmental knowledge for appropriate conservation action, but also revealed that knowledge alone might not be an assurance of future pro-environmental behaviors (Kuhar et al. 2010).

Bioko Island is an especially fortuitous site for exploring the socioeconomic factors driving bushmeat preferences and consumption patterns. The capital of Equatorial Guinea,

Malabo, is located on the northern end of the island, and has most of the people, a mixture of Fang people from the mainland, indigenous Bubi people and relatively few other minor ethnic groups (Liniger-Goumaz 1988). Farther south there are far fewer people, with long established Bubi farming villages, some of which still rely on bushmeat as a dietary component (Vega et al. 2013), and a few more recent Fang hunting villages. There are still remote areas with wildlife to be hunted, and most of the shotgun hunting is commercial, with the harvest being sold in the single bushmeat market in Malabo (Albrechtsen et al. 2005). The price of bushmeat in the Malabo market is higher than that of other sources of protein (Reid et al. 2005), so it is clearly a luxury item in the city.

Because bushmeat hunting and subsequent consumption has been shown to be the major threat to Bioko Island wildlife(Cronin et al. 2013; Vega et al. 2015), we wanted to know more about the characteristics of the people who were eating bushmeat and their reasons for selecting bushmeat rather than other sources of protein. Questions we wanted to address included:

- What are the most preferred sources of protein for the residents of Bioko Island? How does bushmeat compare with other sources? What is the overall pattern of bushmeat consumption on Bioko Island? Does everyone eat some bushmeat or do certain individuals eat most of the bushmeat while others eat very little?
- Are certain characteristics (ethnic group, income level, education level, gender, age, etc.) associated with higher frequencies of bushmeat consumption?
- What reasons do people give for their bushmeat consumption, especially if less expensive sources of protein are available? What are the efficacy of outreach programs designed to discourage the hunting and consumption of endangered species:

- Were people aware of certain programs?
- If they had been exposed to certain programs, did it change their attitude towards hunting and eating endangered species?

Finally, most bushmeat questionnaires have been focused on village consumption by household, but there is evidence that village (rural) bushmeat consumption is not the problem(Robinson & Bennett 2002), especially on Bioko Island. Since most of the bushmeat harvested on Bioko is sold for consumption in Malabo (Albrechtsen et al. 2005), a pattern that is common throughout tropical Africa (Wilkie & Carpenter 1999; Robinson & Bennett 2002), there's a need for more surveys that include these urban consumers for comparison to village (traditional) consumption. Because of the uniquely positive status of the National University of Equatorial Guinea (UNGE) with citizens of Equatorial Guinea, a university-sponsored "man-in-the-street" public opinion survey was possible to gain insight into the attitudes of urban citizens.

Methods

Survey methods:

Questionnaire design: I designed a survey using an anonymous, quantitate questionnaire (Creswell 2013). A pilot version of the questionnaire was administered in August and September, 2013 (Version I); a revised final version was administered in August and September, 2014 (Version II). In both cases, the questionnaire consisted of six parts: 1.) personal information; 2.) personal and household assets; 3.) food preferences; 4.) knowledge about conservation laws and protected areas; 5.) knowledge about Bioko Island's wildlife, including awareness and opinion of the Bioko Biodiversity Protection Program (BBPP)'s outreach initiatives (the Drill monkey documentary video); 6.) knowledge and opinion of the

Moka Wildlife Center. Based on the experience with Version I, some questions were adjusted for greater clarity and new questions added for Version II. For example, a question asking about educational level of the respondents was added and there were two additional sections with questions for respondents who identified themselves as either a farmer and/or hunter or as a bushmeat market vendor. Both questionnaires were approved by the Institutional Review Board at Drexel University (IRB ID#1308002258 and IRB ID#1308002258A001).

Survey procedures: The survey procedures were essentially the same in both the pilot and final surveys. The differences were the revisions in the questionnaire itself (noted above and discussed below) and in the locations where the survey was conducted (explained below).

I first conducted a pilot survey (Version I) in the late summer of 2013 (N =322, predominantly urban respondents) and then, following revisions of the pilot questionnaire and adjustments in the sites where the survey was administered, a second survey (Version II) in the late summer of 2014 (N = 393, predominantly rural respondents) (Table 3.2).

I trained two students, Amancio Motove Etingue and Francisco Mitogo Micha, from UNGE's Department of Environmental Sciences, on how to administer the 20 to 30 minute survey. Training extended across four days and included practice surveys done with them, and additional training once they had begun doing their own surveys. This training also included helping them understand the protocols associated with the survey process that were necessary to meet the standards of Drexel's Institutional Review Board (IRB). They also successfully passed Drexel University's online Collaborative Institutional Training (Mr.

Motove Etingue, reference ID#13306564 and Mr. Mitogo Micha, reference ID#13306566). The same two students administered the questionnaires in both Survey I and Survey II.

The two student survey administrators were from the two major ethnic groups (Fang and Bubi) in Equatorial Guinea thereby facilitating interaction with potential respondents. They wore their UNGE student identification cards prominently displayed on lanyards, and conspicuously carried clipboards with copies of the questionnaire to reassure respondents that the study was not subversive.

The two interviewers approached potential respondents (citizens who appeared to be at least 17 years of age) at random to ask if they were willing to participate in an UNGE-sponsored survey. Once respondents indicated they met the criteria and were willing to participate, the interviewer read the consent form informing the respondent of the goals of the research, its anonymity, duration, option to end the survey at any time, free choice of leaving uncomfortable questions unanswered and final use of research findings.

Selection of locations: In Version I the majority of the questionnaires were administered in urban locations (Malabo and Luba) because it was difficult to arrange transportation to the more remote (rural) locations we had intended to include. These logistical problems were overcome the following year (Version II) and more of the survey was conducted at rural sites to compensate for under-representation the previous year and to better represent our impression of Bioko Island's population distribution. Version I the questionnaires were administered in 45 locations, 82% urban and 18% rural. Version II was administered in 35 locations, split between 43% urban and 57% rural (Tables 3.1a &3.b; Figures 3.1 and 3.2).

In the cities, surveys were conducted on weekdays but in villages surveys were conducted on weekends when many villagers were at home rather than working on their farms. When we arrived in the villages, we always informed the village presidents about the objectives of our research and showed them copies of our credentials. Only after we were granted permission from these authorities we were able to engage participants in our study. We typically conducted the interviews at or in village schools, church plazas, family houses and main streets. In cities, participants were recruited from open, well-travelled, public places (sidewalks, street corners, cultural centers, university campuses, government buildings, parks, markets, highly populated neighborhoods and church plazas).

Data analysis:

Collected data were reviewed and entered into an Excel database to facilitate analysis. We investigated a number of potential relationships: 1.) identifying differences in key study population variables; 2.) household assessment and bushmeat consumption frequencies; 3.) relationship between socioeconomics and bushmeat consumption frequencies; 4.) assessment of patterns between versions I and II; 5.) analysis of bushmeat consumption frequencies versus (age, education); 6.) further analysis of relationships between groups.

Identifying differences in key study population variables: We used the Chi-square test to examine dependence versus independence variables to get a better understanding of the differences among variables (Quinn & Keough 2002): 1.) distribution of age cohorts versus (sexes, ethnicity); 2.) education levels versus (ethnicity, bushmeat protein preferences and bushmeat consumption frequencies); 3.) bushmeat type last consumed versus ethnicity; 4.) location of last bushmeat consumed versus (gender, age cohorts, urban and rural areas, ethnicity and education levels); 4.) use of personal funds to purchase bushmeat across (age

cohorts, education levels, gender, location and ethnicity); 5.) importance of bushmeat diet for dietary needs across (age, education levels, sexes, location and ethnicity); 6.) purchasing location of last bushmeat consumed across urban and rural areas; 7.) wildlife protection from overhunting across (age distributions, education levels and location); 8.) affordable fee to protect biodiversity conservation versus (education levels, age ranges and location); 9.) knowledge about the Moka Wildlife Center across education levels; 10.) making a visit to the Moka Wildlife Center across education levels; 11.) knowledge about the number of protected areas on Bioko Island across education levels; 12.) knowledge about the decree on tourism versus education levels. Those were questions that mainly appeared in one of the survey versions.

We used Fisher's exact test to understand the differences among different variables for contingency tables with small sample sizes (N<3) (Quinn & Keough 2002): 1.) knowledge about the decree on primates versus location.

Furthermore, in situations in which we had large tables (>2x2) and it was difficult to determine which variables were significant via the Chi-square test, we used log odds ratio (Quinn & Keough 2002): 1.) knowledge about Bioko's protected areas versus education levels; 2.) knowledge about the existence of the Moka Wildlife Center versus education levels; 3.) making a visit to the Moka Wildlife Center versus education levels.

Household wealth assessment and bushmeat consumption frequencies: We used a standard basket of owned assets to assess in greater detail the possible relationships between Fang and Bubi ethnic groups' socioeconomic statuses (Brashares et al. 2011). Other researchers using the same basket of owned assets technique used 21 common household items to determine the socioeconomic statuses (SES) of its respondents (Eves & Ruggiero

2000). Likewise, we used 21 common household items and services (land ownership, floor material, wall material, toilet facility, electricity, drinking water well, TV-cable, personal satellite dish, internet at home, air conditioning, freezer, refrigerator, laundry machine, dryer, microwave, smart phone, phone credit, flat screen TV, box TV, laptop computer and cars/trucks) to evaluate the socioeconomic statuses of Fang and Bubi ethnicities. Just like in other places in Africa (Brashares et al. 2011), land ownership is very complex in Equatorial Guinea; consequently, I eliminated it from the overall analysis, and then I ended using only the remaining 20 measures.

We assigned specific numbers, either positive or negative, based on the quality and type of particular items and their owners, either from the Fang or Bubi ethnic groups, tended to gain or lose points. The overall tallying of those measures for all respondents in each ethnic group represented the SES of their respective groups (Takasaki et al. 2000).

Relationship between socioeconomic status and bushmeat consumption frequencies: Using the compiled dataset about SES, bushmeat consumption frequencies and ethnicity, we extracted specific data about highest (>20) to lowest (<5) socioeconomic statuses, highest (9 and 4.3 times per month) to lowest (0.166 and 0.083 times per month) bushmeat consumption frequencies from each ethnicity. We ignored the data of respondents in middle socioeconomic statuses and middle bushmeat consumption frequencies for each ethnicity because there was no clear pattern between them. We wanted to know whether extremes in socioeconomic status would result in extreme bushmeat consumption frequencies. We used a randomization test to assess whether bushmeat consumption frequency (highest or lowest) is independent of ethnicity (Bubi or Fang) (Quinn & Keough 2002). We performed a chi-squared test of independence on a 2x2x2 contingency table (highest and lowest SES groups,

highest and lowest bushmeat consumption frequency, and ethnicity). A distribution of permuted chi-squared statistics was subsequently generated via randomizing the contingency table with respect to ethnicity. We then calculated the probability that the permuted chi-squared statistics were greater than the empirical statistic, using $p<0.05$ to define significance.

Assessment of patterns between version I and version II: We used Logistic Generalized Linear Model (LGLM) to understand the relationship between certain comparable questions from version 1 and version 2 (Agresti 1996; Weiffenbach 2010). The questions involved in this procedure were: 1.) gender distribution by location; 2.) geographical distribution of ethnicity by location; 3.) bushmeat protein preferences versus (sexes, location, and ethnicity); 4.) preferences for other type of proteins (fish, chicken, and beef) versus (location, ethnicity); 5.) most preferred bushmeat animal for food (duikers, porcupine, giant pouched rat and pangolin) versus ethnicity; 6.) bushmeat consumption frequencies versus (ethnicity, gender, location); 7.) knowledge about the decree on tourism across occupation sectors; 8.) usage of Equatorial Guinea's National TV (EGTV) station to view the drill monkey documentary across location; 9.) viewers of the drill movie documentary versus location; 10.) changes in attitudes by viewing the drill movie documentary versus age classes; 11.) knowledge about the Moka Wildlife Center (MWC) versus location; 12.) usage of EGTV to learn about the MWC versus location.

In testing for statistical patterns across factors of interest (ethnicity, protein preferences and design of the survey etc.), we first constructed the following 3 logistic generalized linear models (full models):

1. $\ln\left(\frac{p}{1-p}\right) = I\mathrm{o} + I1(Factor) + I2(Year) + I3(Factor{:}Year)$

2. $\ln\left(\frac{p}{1-p}\right) = I\text{o} + I1(Occupations) + I2(Year) + I3(Occupations{:}Year)$

3. $\ln\left(\frac{p}{1-p}\right) = I\text{o} + I1(Age\ cohorts) + I2(Year) + I3(Age\ cohorts{:}Year)$

Where, $\ln\left(\frac{p}{1-p}\right)$ is the logit link function; I_0 represents the indicator or dummy variable and it takes values 0 (false) or 1 (true). Factor indicates response variables such as ethnicity, gender, location, occupations and age cohorts. Factor (*) Year represents the interaction and in most of the models there was only one interaction; however, for categorical factors like occupations and age cohorts the models had multiple levels.

The response variables are coded as follows: bushmeat consumption (consumer=1, non-consumer=0), gender distribution (male=1, female=0), ethnicity distribution (Fang=1, Bubi=0). All binary factors were coded as ethnicity (Fang=1, Bubi=0), location (urban=1, rural=0), year (2014=1, 2013=0), and gender (male=1, female=0). Occupation was a categorical factor for education, construction, government, and other; and age was a categorical factor for five age bins: <20, 20-29, 30-39, 40-49, and 50-59. For these two last models the occupation sector, education, and the age cohort, <20, were coded as (0); hence, they behave as intercepts.

In the process of testing the null hypotheses, for each full model, we constructed reduced models that contained a subset of factors. We used the Akaike Information Criterion (AIC) to guide model selection and confirmed superiority of models by the significance of the reduction in deviance by a Chi square statistic (Agresti 1996; Weiffenbach 2010).

Analysis of bushmeat consumption frequencies versus age ranges and education: Bushmeat consumption frequencies from both surveys were clumped into two extreme categories high (once per week or more) and low (approximately once per month, approximately once per year/never). We used LGLM to analyze the patterns of these extreme bushmeat consumption frequencies across age ranges between version I and II. Utilizing the same frequency levels (high and low) for version two only, we used LGLM to look for important patterns across education levels from the same version. These education levels were split into three categories low (none and primary), middle (secondary and vocational) and high (university).

Further analysis of relationships between groups: We used the post hoc test, specifically Tukey's honestly significant different (HSD) test to assess the differences among certain groups(Quinn & Keough 2002): 1.) occupation sectors versus knowledge about protected areas on Bioko;2.) bushmeat protein preferences versus age cohorts; 3.) drill project viewers versus age cohorts; 4.) knowledge about Moka Wildlife Center versus age cohorts.

All the statistical analysis were carried out using version (3.2.2) of the statistical software R Core Team (2015). The alpha level for all statistical tests was set at $p<0.05$.

Results:

Characteristics of the respondents:

A total of 715 questionnaires were included in the analysis of the two surveys described above: 322 from Survey I and 393 from Survey II. Although there was no

systematic attempt to balance the gender ratio, age cohort, ethnic group or educational level of the respondents, the students who administered the questionnaires were instructed to maximize diversity in recruiting subjects. The only intended difference between Survey I and Survey II was the addition of more rural locations in the second survey ($x^2=272$, df=1, $p<0.0001$): more questionnaires (86%) were administered in urban areas in version I than in version II (24%)(Table 3.2).

Overall, the survey respondents were 52% urban and 48% rural, 60% male and 40% female, and predominantly in the 20 to 29 year age cohort (39%). The respondents were almost equally likely to be Fang (48%) or Bubi (46%), with far fewer from all other ethnic groups (6%). Almost 60% of the respondents had a secondary school education and over 13% were university-educated (Table 3.2).

The distribution of socioeconomic status (SES) scores demonstrated a realistic representation of genders, locations and ethnic groups. For example, major ethnic groups were represented in the SES cohorts at a rate that reflected their overall representation in the respondent pool, which in turn reflected their perceived numbers in the population (Figure 3.3). Of course, without official government census numbers, it is impossible to do an actual comparison.

Factors influencing food choice on Bioko Island:

Favorite food choices: The first step in examining the demand for bushmeat was to determine the popularity of bushmeat with consumers, and what other protein preferences existed. Respondents in both surveys were asked to select their favorite source of protein from a list that included beef, chicken, fish, pork, goat, turtle, bushmeat, beans and other

(goat meat, snails, and processed meats). In both surveys, bushmeat was the overwhelming choice of well over half the respondents, with fish and chicken coming in a distant second and third with fewer than 20% of respondents selecting either of them as a favorite. Beef and pork were chosen even less frequently. In Version I: bushmeat 57%, fish 17% and chicken 14%. In Version II: bushmeat 69%, fish 12% and chicken 10 % (Figure 3.4).

Somewhat surprisingly, there was a very significant increase in the popularity of bushmeat between survey Version I, administered in summer 2013, and Survey version II, administered in summer 2014 ($x^2=14$, df=1, $p<0.0001$). There was a corresponding decrease in the popularity of other protein sources.

To better understand the demand for bushmeat we next explored what other characteristics were associated with the respondents who favor bushmeat. For example, were bushmeat lovers more likely to be men rather than women? Or were bushmeat lovers more likely to be older people, or rural people, or less educated people?

We found that there were no statistical differences in the frequency of men and women selecting bushmeat as their favorite in either survey via LGLM. We also found no statistical difference in the frequency of bushmeat preference by location in either survey. Urban respondents were no more or less likely to prefer bushmeat than rural respondents in both surveys. In version I, 57% of urban respondents and 52% of rural respondents preferred bushmeat. In version II, 73% of urban respondents and 79% of rural respondents preferred bushmeat. The LGLM revealed a significant interactive effect ($p<0.001$) caused by the observed change in bushmeat preferences in each location ($p<0.0001$) between both surveys (Table 3. 3).

We also found no significant differences in the preference for bushmeat among respondents with different educational levels or between respondents from the two major ethnic groups (Fang and Bubi).

However, we did find that there were significant differences between age cohorts. In both surveys, analysis of variance indicated statistically significant differences both between the surveys ($p<0.0001$) and between age cohorts ($p<0.001$). In both Version I and Version II, Tukey's HSD test showed that the means of age classes 17-19 years and 30-39 years differed significantly (Tukey-Kramer test, $p<0.001$), suggesting that respondents in the 17-19 year cohort were significantly more likely to prefer bushmeat protein than those in the 30-39 year age cohort.

Non-bushmeat food choices: We also looked at the characteristics of those (relatively few) respondents who selected something other than bushmeat as their preferred source of protein. We learned (LGLM) that rural respondents (39%) were more likely to prefer fish than urban respondents (13%) in the first of the two surveys ($p<0.001$); and that Fang respondents (5%) were more likely to prefer beef than Bubi respondents (0.4%) in the second of the two surveys ($p<0.02$) (Table 3.4).

Favorite bushmeat species: Because bushmeat hunting threatens certain species more than others, we decided to look more carefully into the preferences for particular bushmeat categories or species. To that end, we asked those respondents who preferred bushmeat to select the bushmeat species that they most enjoyed eating. We limited our

analysis to the five species (or species categories) that were most often named as favorites by the respondents. These species, or the species that made up a category were: antelope (blue duiker, *Cephalophus monticola;* and Ogilby's duiker, *Cephalophus ogilbyi);* monkeys (drill, *Mandrillus leucophaeus;* black colobus, *Colobus satanas;* Pennant's red colobus, *Procolobus pennantii*; Bioko red-eared monkey, *Cercopithecus erythrotis erythrotis*; Bioko putty-nosed monkey, *Cercopithecus nictitans martini*; golden bellied crowned monkey, *Cercopithecus pogonias pogonias*; Bioko Preuss' monkey, *Allochrocebus preussi insularis)*; brush tailed porcupine, *Atherurus africanus;* Emin's giant pouched rat, *Cricetomys emini;* and tree pangolin, *Manis tricuspis.*

When asked to select the bushmeat species or species group which was their favorite for eating, respondents in Version I chose antelope/duikers (40%), porcupine (33%), pangolin (12%), monkeys (7%) and giant pouched rat (2%). Respondents in Version II selected duikers/antelope (38%), porcupine (21%), pangolin (11%), giant pouched rat (11%) and monkeys/apes (7%) (Figure 3.5).

We compared the two major ethnic groups on Bioko Island to see if there were any differences in preferred bushmeat species. In survey Version I, the top four most preferred bushmeat species by the Fang were porcupine (41%), antelope/duikers (26%), pangolin (16%) and monkeys/apes (10%) and by the Bubis the preferred species were antelope/duikers (71%), porcupine (15%), giant pouched rat (6%) and pangolin (5%). In Survey II Fang respondents selected porcupine (22%), pangolin (21%), antelope/duikers (20%) and monkeys/apes (19%) while Bubi respondents chose antelope/duikers (45%), porcupine (27%), giant pouched rat (13%) and pangolin (3%) (Figure 3.5).

When the preference for monkey/ape bushmeat by the two major ethnic groups (Fang and Bubi) was compared, the LGLM showed that Fang participants were more likely to prefer primate bushmeat than Bubi in both surveys ($p<0.0001$): in version I (8.3 vs 0.7 percent, respectively) and version II (16.6 vs 1.42, percent, respectively) (Table 3.5).

When the preference for antelope/duiker bushmeat by the two major ethnic groups (Fang and Bubi) was compared, the LGLM showed that Bubi respondents were more likely to prefer blue duiker than Fang in both surveys ($p<0.0001$): Version I (48% vs 21%) and Version II (40% vs 16%) (Table 3.5).

The ethnic group differences in bushmeat species preferences extended to other species as well: the LGLM showed that Fang respondents were more likely to prefer tree pangolin than Bubi in both surveys ($p<0.0001$): version I (13 vs 2.3 %) and version II (18 vs 3.3%) (Table 4.8). Similarly, the LGLM revealed that Fang subjects were more likely to prefer porcupine in the first of the two surveys ($p<0.0001$): version I (32 vs 10 %) (Table 3.5).

The LGLM showed that Bubi subjects were more likely to prefer Emin's giant pouched rat in both surveys ($p<0.001$): version I (4.5 vs 1.5 percent) and version II (12 vs 4.2 percent) (Table 3.5).

Recall of last bushmeat meal: To determine if respondent's stated preferences in bushmeat species were reflected in their actual eating habits, we looked at the results of the question "The last time you ate bushmeat, what kind of bushmeat did you eat?"

The type of bushmeat last consumed varied significantly between urban and rural respondents ($x^2 = 27.9882$, df=5, $p<0.0001$): those in the cities were more likely to eat

porcupines, monkeys and tree pangolin, 28, 6 and 3.7 percent, respectively, as opposed to those from the countryside who were more likely to eat giant pouched rat and duikers, 32 and 48 percent, respectively (Figure 3.6).

The type of bushmeat last consumed among Fang and Bubi respondents varied significantly (X^2=32, df=5, p-value<0.0001): Fang were more likely to have eaten porcupine 30% and monkeys 6%; in contrast to Bubi who were more likely to have eaten duikers 50% and giant pouched rat 32% (Figure 3. 7).

Frequency of bushmeat consumption: Although bushmeat was the overwhelming favorite source of protein among respondents, it was consumed relatively rarely. In version I, which had mostly urban respondents, more than 52% of respondents reported eating bushmeat infrequently, only once a month or less; 16.2% reported eating bushmeat about once a week or several times per month; and, only 3.6% reported eating bushmeat daily or several times per week. Even in version II, which had more rural respondents, more than 47% of respondents reported eating bushmeat infrequently, only once a month or less; 20 % reported eating bushmeat about once a week or several times per month; and, 16.3% reported eating bushmeat daily or several times per week (Figure 3.8).

In both Version I and Version II we (LGLM) found no significant differences in bushmeat consumption patterns due to gender (male or female), or the location (urban or rural), or ethnic group (Fang vs Bubi) of the respondents (Table 3.3).

In a more detailed analysis of bushmeat consumption frequencies vs socioeconomic status of bushmeat consumers, the empirical data regarding the socioeconomic statuses highest (>20) to lowest (<5) of bushmeat consumers and the bushmeat consumption

frequencies highest (9 and 4.3 times per month) to lowest (0.166 and 0.083 times per month) across Fang and Bubi respondents exhibited significant differences (x^2= 28, df=3, p<0.0001): Bubi with high socioeconomic status had higher bushmeat consumption frequencies than Fang from the same category (55 vs 11 %); in contrast, Fang subjects with low socioeconomic status had high bushmeat consumption frequencies when compared to Bubi in the same low SES category (87 vs 46%) (Figure 3.9).

The observed pattern across socioeconomic status of bushmeat consumers, bushmeat consumption frequencies and ethnicity (Fang vs Bubi) was strongly supported by a randomize test which yielded statistically highly significant results (p < 0, 0001): that suggests that the relationship among Fang and Bubi's socioeconomic statuses and their bushmeat consumption frequencies is very likely.

Relationships between bushmeat consumption frequencies and other respondent traits were also investigated. We compared the extremes of bushmeat consumption frequencies-high bushmeat consumption frequencies (approximately once per week or more) and low bushmeat consumption frequencies (approximately once per year or never)-from both surveys versus respondents' age cohorts.

The (LGLM) yielded a significant main effect of survey version (p<0.0001), but the relationship across age cohorts and those extremes bushmeat consumption frequencies was not significantly different between both versions I and II (p=0.2083, Figure 3.10). We reasoned that the increase of high bushmeat consumption frequencies in version II led to a decrease of the low bushmeat consumption frequencies and that may have been responsible of the significant year effect in the system.

The LGLM revealed significant differences regarding bushmeat consumption frequencies across education levels ($p<0.0001$): highly educated individuals (94 %) were more likely to have low bushmeat consumption frequencies than subjects from mid (65%) and low (63%) education levels (Figure 3.11).

Location of last bushmeat meal: With the increasing urbanization of Bioko Island, we wanted to know if bushmeat was still primarily a home-cooked meal. When we asked (Version II only) where respondents had eaten their last bushmeat meal, the vast majority (81%) stated that the meal had been consumed at home, rather than away from home (18%), for example in a restaurant. Although there was no difference by ethnic group (Fang or Bubi), we found that the location (urban or rural) of the last bushmeat meal consumed differed significantly between urban and rural subjects ($x^2 = 10.3017$, df=1, $p < 0.001$): in rural areas, last bushmeat meal consumed took place at home 85% of the time but in urban areas only 69% of the time. In addition, the location of last bushmeat meal consumed contrasted significantly across gender ($x^2=4.7$, df=1, $p<0.01$): 87% female were more likely to have consumed their last bushmeat meal at home than 78% male (Table 3.6).

Likewise, we also found a significant difference between certain age cohorts ($x^2 = 13.891$, df=4, $p < 0.001$): those in the 20-29 year age cohort were more likely to eat away from home than those in the >50 year cohort (Table 3.6).

And finally, the location (home vs away from home) of last bushmeat meal exhibited significant differences across education levels ($x^2=12$, df =4, $p=0.01$): respondents with no education were significantly more likely to consume their last bushmeat at home (100%) when compared with those who were university-educated (65 % consumed their last bushmeat meal at home) (Table 3.6).

Perceived dietary importance of bushmeat: When asked (only in Version II) if they believed that bushmeat was a critical component for their dietary needs, 68% of the respondents agreed. However among those agreeing, we found no significant differences between sexes, or among age cohorts, or between locations, or between ethnic groups. However, educational levels did show significant differences (x^2= 14.406, df=4, $p < 0.001$), at least between the most educated and the least educated groups: 87% those with the least education agreed with the importance of a bushmeat diet, significantly more than the 43% of the university-educated respondents who agreed (Fig. 3.12)

When those who had indicated that bushmeat fulfilled important dietary needs were given a choice of possible reasons why they believed that a bushmeat diet was important, the responses were spread between the choices. The most common responses were 'because it was the favorite food', and 'because it was fresh (not frozen or smoked) food.' Only about 10% believed bushmeat provided health benefits, and less than 10% (both Surveys) mentioned any cultural reasons for eating bushmeat (Figure 3.13). There were no differences between urban and rural respondents or between Fang and Bubi respondents.

We also asked (Versions I and II) respondents if there were any wild animals that they would not eat due to tradition or taboo. Out of the total of 715 respondents, 194 reported forbidden species, but there was no significant pattern by species (or species category), or by the gender or ethnic group of the respondent (Table 3.7).

Attitudes towards wildlife conservation on Bioko Island:

In Version II, a series of questions was designed to explore the attitudes towards biodiversity conservation. Respondents were asked if wildlife should be protected from over-hunting, and if they would be willing to pay a small fee to accomplish this protection.

The proportion of respondents who thought it was important to protect wildlife from overhunting differed significantly with location (x^2=12, df=1, p<0.0001): urban respondents were more likely to be supportive than those from rural areas (88% vs 68 %). There were significant differences across age ranges (x^2 = 29.3, df=4, p<0.0001): respondents in <20 year cohort (90%) were more likely to support that idea than those in the 50-59 year cohort (55%). Education also resulted in significant differences (x^2= 10.751, df=4, p =0.029): university educated participants were more likely to be in favor and those without any education were least likely (84% vs 50%) (Table 3.8).

A similar pattern was revealed when respondents were asked if they would be willing to pay for wildlife protection. The proportion of respondents who were willing to provide an affordable fee for biodiversity protection differed significantly with location (x^2=10.695, df=1, p-value<0.001): urban respondents were more likely to be supportive (89%) than rural respondents (71%). There were significant differences across different age cohorts (x^2=13, df=4, p-value<0.0001): younger respondents, especially those <20 (92%) were more likely to be in favor of protection than respondents in the 50-59 year cohort (72%). Education level also showed significant differences (x^2=11.112, df=4, p =0.025) with an overall trend supporting the notion that more education led to more willingness to pay a fee, but the only significant difference was between those with the least education (50% in favor) and those with a vocational level education (93% in favor)(Table 3.8).

For those respondents in Survey II who indicated that wildlife should be protected from overhunting (N=263), we asked that they indicate why they thought this should be so. They were given a choice of responses and asked to select the single most important reason. The choices were tourism, natural heritage preservation, hunt and trap for food, hunt and trap for income, and biodiversity preservation. They were allowed to offer other reasons.

Responses provided by urban and rural participants differed significantly ($x^2=34.3$, df=5, $p<0.0001$): urban people were more likely to report tourism, 53%, hunting and trapping for income, 10%, whereas rural responses were tilted towards natural heritage preservation, 35%, biodiversity protection, 19%, hunting and trapping for food, 13% (Figure 3.14).

Different reasons for wildlife protection from overhunting were provided throughout education levels and the most common in each group were: no education, primary school and vocational education respondents selected “for people to hunt or trap for food” most often; secondary education respondents selected “for people to hunt or trap and sell for income”; educated respondents selected “for tourists to see.”

All respondents in both surveys were asked if they were in support of initiatives aimed at protecting wildlife for the purpose of promoting ecotourism, and in both surveys, an overwhelming number responded in the affirmative: 92% of the 309 responses in Version I; 88% of the 360 responses in Version II).

Public awareness of protected areas and conservation-related laws

Awareness of protected areas: Two large protected areas (Pico Basile National Park and Gran Caldera and Southern Highlands Scientific Reserve) make up more than 40%

of Bioko Island. When we asked respondents if they knew how many protected areas were on Bioko Island 22.4% in Survey I and 15.2 % in survey II gave the correct answer.

We looked to see if respondents with certain occupations were more likely to know the correct answer. The ANOVA testing knowledge about the number of protected areas on Bioko Island across occupation sectors (education, construction, government and other) was significant ($p<0.0001$). In both version I and version II, Tukey's HSD test suggested that the means of the occupations "other" and government were significantly different to education and construction (Tukey-Kramer test, $p<0.05$). That is, respondents from the occupations "other" and government were less likely to know the right number of Bioko Island's protected areas as opposed to those from the education and construction sectors.

We (Version II only) also looked to see if respondents with higher educational levels were more likely to know the correct answer. Across education levels, respondents from the university level were more likely to know the number of protected areas found on Bioko than all other education levels (Ln (odds ratio) =1.92; 95% CI= 2.619, 1.239) (Figure 3.15).

Awareness of the Presidential Decree banning the hunting and consumption of primates: In 2007, the president of Equatorial Guinea issued a decree banning the hunting, consumption and selling of all primates throughout the country, both as a health initiative and as a conservation initiative. Although it was briefly effective, a lack of enforcement quickly led most citizens to ignore it. We asked those respondents who identified themselves as farmers, bushmeat hunters or bushmeat vendors if they were aware of this decree. More than half of the respondents from both urban and rural areas were aware of the existence of the

decree (83 vs 75 percent, respectively) prohibiting the hunting, consumption and selling of monkeys and primates in Equatorial Guinea-(Figure 3.16).

Awareness of the Decree concerning tourism: In 1991, the President of Equatorial Guinea enacted a decree, regulating photography and the free access to all tourist attractions throughout the country. Despite the existence of this piece of legislation, tourists are not well received in the country and taking pictures can easily get someone in trouble, regardless of whether you have a government issued tourist permit or not. We asked all respondents (Version II) if they were aware of this decree.

There were no significant difference in knowledge of this decree across occupations, but there were significant differences across educational levels. Public knowledge about the existence of the decree on tourism differed significantly across education levels (x^2= 23.974, df=4, p <0.0001): secondary, vocational and university, 60% for each one of them, respectively, were more likely to be aware of the decree, as opposed to primary and none education, 40 and 11%, respectively (Figure 3.17).

Opinions about the effectiveness of having a well-paid, motivated, equipped and government-supported body of forest guards in the protected areas to reduce illegal hunting were statistically significant between version I and II confidence interval (Ln (odds ratio) = 0.57; 95% CI= 0.932, 0.2210): respondents in version I were more likely to strongly agree than those from version II (43 vs 26 percent, Figure 3.18).

Participants were asked, only in version I, to provide their opinions regarding the gradual loss of primates in the forest which can cause drastic changes in ecosystem

functioning and composition. Their opinions varied significantly (Ln (odds ratio) =0.48; 95% CI= 0.813, 0.156): 39% of subjects agree and 28 % strongly agree (Figure 3.19).

Public recommendations towards the effective implementation of conservation policies in Equatorial Guinea differed significantly between version I and II (x^2=42.3, df=5, p<0.0001): respondents were more likely to report awareness campaigns (28%), implement protected areas (14%) and wildlife patrols (21%) in version I and alternatives (13%) and law enforcement (43%) were more common in version II (Figure 3.20).

Evaluation of BBPP Outreach Efforts:

We asked our participants several questions designed to evaluate the awareness and efficacy of two major conservation outreach efforts by BBPP: a 35 minute documentary about the daily life of the elusive drill monkey in its natural habitat on Bioko Island that had been shown frequently on the national TV station during 2013; and, the Moka Wildlife Center, a field station and nature center open to the public that had been established in the village of Moka in 2008.

The drill monkey documentary video: Overall, more than 52% of the respondents had seen the drill documentary. However, there was a significant difference between surveys (x^2=18.6, df=1, p<0.0001): respondents in version I were more likely to have seen the drill film than those in version II (61% vs 44 %).

The LGLM showed no significant differences regarding the source (EGTV vs 'Other') used to view the drill documentary between urban and rural respondents, nor did it show any significant differences across age cohorts versus changes in attitudes; however, it yielded significant differences in the number of viewers from urban and rural areas in the

first of the two surveys ($p<0.01$): 53 % urban participants were more likely to have seen the documentary than 41% rural (Table 3.10).

The ANOVA test indicated that both survey year and age cohorts were statistically significant ($p<0.0001$ and $p<0.0001$). In both versions I and II, Tukey's HSD tests exposed that the means of respondents <20 years contrasted significantly from 20-29 years (Tukey Kramer test, $p<0.001$) and 30-39 years (Tukey Kramer test, $p<0.01$). All other age cohorts were not significant. Therefore, respondents <20 years were less likely to have seen the Drill project documentary than those in groups 20-29 years and 30-39 years.

The Moka Wildlife Center: Overall, 64% of the respondents knew of the Moka Wildlife Center. Knowledge about the MWC varied significantly between both surveys ($x^2=6.5$, $df=1$, $p<0.01$): 70% of participants knew about the existence of the MWC in version 1 and 60% in version 2.

In both surveys, the LGLM found no significant variations regarding the awareness of the MWC by location (urban vs rural); nonetheless, concerning type of source (EGTV vs 'Other') used to learn about the MWC between urban and rural respondents it was marginally significant in the first of the two surveys ($p=0.05$): 55% of urban respondents were more likely to use the EGTV than 35% rural (Table 3.10).

The effects of both age cohorts ($p<0.001$) and survey year ($p<0.01$) provided by the ANOVA test were highly significant. In both version I and version II, Tukey's HSD tests revealed that the means of respondents between 50-59 years were significantly different from those between 20-29 years (Tukey Kramer test, $p<0.001$) and 30-39 years (Tukey Kramer

test, $p<0.01$). All other comparisons of groups across the years were not significant. In other words, respondents between 50-59 years were less likely to know about the existence of the Moka Wildlife Center compared to those between 20-29 years and 30-39 years.

Across education levels (version II only), respondents with university education (84%) were more likely to know about the existence of the Moka Wildlife Center than any other education level (Ln (odds ratio) = 1.45; 95% CI= 2.286, 0.613, Figure 3.21); in addition, highly educated respondents were more likely to have made a visit to the Moka Wildlife Center compared to all other education levels (Ln (odds ratio)= 1.29; 95% CI =2.029, 0.556, Figure 3.22)

In both version I and version II, making a visit to the Moka Wildlife Center resulted in a positive impact (86 percent, from each version) on the majority of respondents; virtually all subjects, 96%, were supportive of the idea of a potential expansion of the Moka Wildlife Center to other regions in Equatorial Guinea (Figure 3.23).

Discussion:

Respondent profile: The goal of this project was to determine the attitudes of the people of Bioko Island regarding bushmeat consumption and wildlife protection, but we were handicapped by two considerations: First, given the negative attitude of the Equatoguinean government towards public opinion polls, would we be able to enlist participants even if they remained anonymous? And second, do the participants adequately represent the EG citizens living on Bioko Island?

Our first concern was immediately dismissed as we discovered that our UNGE student team, with their prominent student ID's, their clipboards and professional demeanor reassured potential participants so that approximately 70% of those approached agreed to

participate. The only hesitation came in the second year, when some participants were wary of the topic because of the connection between bushmeat and the on-going Ebola epidemic in other parts of West Africa. Some participated after being assured that there were no Ebola questions, but others declined. Although it would have been very informative to include Ebola-related questions, it was too late to get IRB approval at Drexel, and too volatile a topic for UNGE approval.

To allay our second concern, that participants recruited on the street might not produce a representative cross section of Bioko Island citizens, we have analyzed the characteristics of our questionnaire respondents in some detail.

For example, we classified the locations in which our questionnaires were administered into two categories: urban and rural. Our decision for designating a location as either urban or rural was based on local perception. Malabo was obviously "urban" and its expansion now encompasses formerly suburban areas like Paraiso. Villages near Malabo like Sampaka are now suburban. With the development of the port at Luba, it too became "urban." Other villages on the island remained rural. The accuracy of these designations becomes important in understanding bushmeat consumption patterns, especially in making comparisons to other studies. Since our surveys, the government of Equatorial Guinea has released preliminary results from a national census done in 2012 and we can evaluate our designations

- Most people on Bioko Island live in the urban areas, especially Malabo and its rapidly expanding suburbs. This pattern was confirmed: In the province of Bioko Norte, which includes the capital city of Malabo, only 9.2 percent of the population is

classified as living in a rural area as opposed to Bioko Sur where more than half of its population, 57.4 percent, still resides in a rural area (Censo de población. República de Guinea Ecuatorial 2015).

- Population density is higher in Bioko Norte than in Bioko Sur, which has only one large town (Luba) and a large, almost uninhabited scientific reserve. The official census gives a density of 386 people per km² in Bioko Norte compared with 27.9 people per km² in Bioko Sur.

The recent government census did not provide the criteria used in classifying locations between urban and rural areas, but it is likely that the government considered the following categories: urban districts; capital of provinces; villages converted into municipalities; and, villages. If we were to regroup the locations of our data collection sites between urban and rural based on the hypothetical criteria used by the government and compared across the pilot study 2013 (89 vs 11 percent), the revised final 2014 (69 vs 31 percent) and the government census (86 vs 14 percent) (Table 3.11). Our study was limited to citizens but the government census also included persons who were not citizens.

The distribution of respondents into representative age cohorts was also a concern that was not addressed in the recently released government census. In both versions of our survey, respondents were most often in the 20-29 yr. age cohort. The age cohorts of a nearby country, in this case Cameroon, followed a similar pattern (Table 3.12).

The preponderance of men (60% in both surveys), again a demographic feature not released as part of the official government census, may reflect reality. There is a perceived influx of (Fang) men from Rio Muni, seeking work in the rapidly growing capital city.

An “educational level attained” question added in Survey II revealed that our respondents were generally well-educated. The majority (59%) had secondary education and far fewer had only a primary school education (19%) or no education (2%). Some respondents had vocational school training (6%), and 13% had a university education, a number that might have been inflated due to the proximity of survey locations to the university.

Interestingly, compared to its neighboring countries Gabon 88.4%, Cameroon 75%, Sao-Tome and Principe 89% and Nigeria 61.3%, Equatorial Guinea 93.9% has the highest literacy rate in the region (*African Statistical Yearbook, 2015*). The very low number of respondents (2%) reporting no education and the relatively low number reporting only a primary school education (19%) suggest that the official literacy rate is reasonably accurate.

Our impression of literacy levels was further reinforced by experiences during the survey. We came across very few people who could not understand Spanish, which, as the official language of Equatorial Guinea, is learned in schools. For instance, it was more likely to have encounters with people who did not understand Spanish in Fang hunting villages like Fortune and Boco Drumen, where older respondents often required the assistance of a (Fang) translator to take the questionnaire. We reasoned that some of those individuals may have grown up in the interior of the mainland before Equatorial Guinea was granted its independence from Spain. In that period, many of the schools available across the country were in Malabo, Bioko Island and Bata (Table 3.13). The fact that those people grew up in the interior of the mainland may have resulted in a handicap regarding getting access to the very few existing schools in the 1960s.

Approximately the same percentage of Fang and Bubi participants had at least a primary school education (50% Fang and 64% Bubi), but significant differences between the ethnic groups were evident at both the secondary and university levels ($x^2 = 31.528$, df=4, $p < 0.0001$). A greater percentage of Bubi respondents had completed secondary education than Fang (64% vs. 50%) but the reverse was true at the university level where a greater percentage of Fang had completed college than Bubi (25% vs. 5%) (Figure 3.24).

Although these results at first seem paradoxical, the recent history of education in Equatorial Guinea makes them logical. Under the Spanish, Bioko Island and its Bubi inhabitants enjoyed one of the highest literacy rates in Africa, the result of good public and parochial high schools supported by Spanish foreign aid and the Catholic Church. Rio Muni and especially its more remote Fang inhabitants lagged behind. After independence and the disastrous reign of Macias (1968 – 1979), the island of Bioko recovered more quickly, reinstating some of the excellent high schools and again educating its (Bubi) youth. As a result of this better access, more Bubis were able to complete high school.

University level education in Equatorial Guinea has been slower to develop. Under the Spanish, the well-regarded Spanish Extension University was a local but limited option. It was not until President Obiang created the National University of Equatorial Guinea in 1995 that the country had any in-country university option and UNGE remains EG's only university. UNGE provides a tuition-free education to all qualified citizens (the only requirement is that students have to pay a relatively affordable registration fee), thereby attracting bright, high school-educated Fang youth from the mainland. Many of these graduates remain on Bioko to take jobs with the government and with other entities (oil companies and their subcontractors) based in Malabo.

Bushmeat preference and consumption:

Bushmeat is the favorite protein-based meal of more than half the respondents in both surveys. The choice of bushmeat extended across genders, urban and rural locations, major ethnic groups (Fang and Bubi), and all educational levels. This level of preference is much greater than in other comparable surveys. Also, other studies have shown differences in bushmeat preference with location and with ethnic groups.

We had expected that more education and a resulting greater awareness of both the health issues and the conservation issues associated with bushmeat consumption would lead to less bushmeat preference. We also expected that we would find a greater preference for bushmeat among Fang respondents, based on earlier surveys in Rio Muni (East et al. 2005; Fa et al. 2009).

Even more remarkable, both the preference for bushmeat and the reported frequency of bushmeat consumption increased in our Survey II. We are aware of two possible reasons for these increases, one was internal to our methodology, and the other was the result of external factors. First, the internal possibility occurred when we administered the second survey. We added more ad lib commentary to help respondents understand the concept of "favorite protein source" by explaining it as the basic ingredient of the main course at dinnertime. The mental image of a traditional bushmeat-based dinner might have increased its appeal. This interpretation is supported by the only significant difference we found when analyzing the preference, namely the greater preference for bushmeat in the youngest age cohort (17-19 year respondents) compared to the 30 – 39 year cohort in both surveys. Possibly the youngest respondents were still living at home eating traditional dinners, while the older respondents, with more experience eating other cuisines, had developed other preferences.

A second possibility for the increase in bushmeat preference was the international Ebola epidemic of 2014. When we administered the second survey (July and August of 2014) the country of Equatorial Guinea was at the height of its response to the Ebola crisis enveloping West Africa: air traffic with many West African countries had been suspended and the borders to neighboring countries had been closed. Knowledge of the connection between bushmeat, especially primate bushmeat, and the origins of the Ebola epidemic was widespread. In fact, one of the driving factors behind President Obiang's 2007 Decree banning the hunting, killing and consumption of primates, was thought to be the deadly 2007 outbreak of Ebola in the Democratic Republic of the Congo. This unusual awareness of bushmeat might have led to both an increased preference and an increased frequency in recalled rate of bushmeat consumption.

While the two major ethnic groups (Fang and Bubi) shared a similar overall preference for bushmeat, they differed in which bushmeat species they preferred. While both groups consistently named antelope (duikers), porcupines, and tree pangolins among most preferred bushmeat species, the Bubi expressed a significantly greater preference for antelope (duikers) and giant pouched rat than the Fang, while the Fang expressed a significantly greater preference for tree pangolin and primates (monkeys and apes) than the Bubi. This preference is not surprising because on the mainland, tree pangolin is among the top three most preferred bushmeat species by Fang (East et al. 2005) and it is also the most profit oriented species by Fang hunters (Keylock 2002). Also, previous researchers reported a fondness for primate bushmeat by Fang subjects, both on Bioko Island (Fa et al. 2002a) and the mainland, Rio Muni (Pi & Groves 1972). The percentage of Fang expressing the

preference for primates doubled between Survey I and Survey II, another possible indication that the Ebola crisis led to greater interest in primate bushmeat in particular.

This second possibility is supported by a comparison of Malabo bushmeat market dynamics for the two 6-month periods during and immediately before we administered our two surveys (March through August, 2013 and March through August 2014) (Figures 3.25 and 3.26). The proportion of primates among the five most popular bushmeat species declined from almost 30% to less than 10%, an effect that could be attributed to the government response to the nearby Ebola epidemic.

This scenario also provides additional support for a "Mardi Gras" effect in response to legislation, an effect first suggested by Cronin et al (2015), whereby the possibility that bushmeat (or at least certain kinds of bushmeat) would soon become forbidden enhanced its desirability. Just as the 2007 Presidential Decree banning the hunting of primates led to a dramatic increase in primate harvest as soon as it became evident that the decree was not being enforced (but at any moment might be enforced), the same fears of enforcement were resurrected during the Ebola crisis, making bushmeat in general seem all the more appealing.

Neither of the two contradictory predictions (more affluence leads to greater ability to buy more bushmeat vs more affluence leads to greater ability to buy other sources of protein) for the relationship between socioeconomic status and bushmeat consumption received unqualified support from our results. Instead, we found evidence for a more complex relationship depending on ethnic group: the very wealthiest Bubi ate bushmeat more frequently than Fang in the same socioeconomic cohort, while the poorest Fang ate bushmeat more frequently than the poorest Bubi.

Likewise, a relationship between educational level and bushmeat consumption, evidence that better educated citizens ate bushmeat less frequently, was true only for university-educated citizens. (Better educated citizens were however, less likely to believe that bushmeat was a dietary essential.)

Bushmeat is also typically available as a fresh (not smoked or frozen) protein on Bioko Island, a trait it shares with chicken and fish. Because many respondents cited freshness as a reason for choosing bushmeat as a favorite (Figure 3.13), increasing the desirability of other fresh protein sources could decrease the demand for bushmeat.

Attitudes towards wildlife protection were generally positive, with 73% of the respondents in favor of protecting wildlife from over-hunting, even to the extent of paying an "affordable fee" to achieve this goal. These sentiments were strongest among urban, younger, and better-educated citizens. The same citizens were most knowledgeable about the island's protected areas and the country's relevant laws. Well over 60% of respondents supported the concept of well-equipped and trained forest guards, but the level of this support was lower in our second survey. Respondents supported a variety of ideas for achieving wildlife protection, especially "awareness campaigns" but there was a shift towards "law enforcement" in the second survey, perhaps an effect of the Ebola epidemic.

We also evaluated the impact of two awareness activities underway by BBPP: a 35-minute documentary film about the Island's endangered drill monkeys shown repeatedly on national television throughout 2013 and the presence of the Moka Wildlife Center on Bioko Island, established in 2008 as part of the academic partnership between UNGE and Drexel University. The percentage of respondents who were aware of these activities declined

between the first and second surveys, although in both cases the majority of respondents who were aware claimed that the experience had changed their attitudes towards wildlife and its protection, 55% in the case of the drill documentary video and 86% in the case of the MWC. More than 90% of the respondents who had visited the MWC supported expansion to Rio Muni.

In conclusion, our surveys were successful in targeting a typical cross-section of Equatoguinean adults living on Bioko Island, and therefore we have recorded for the first time, the anonymous "man in the street" attitudes toward bushmeat and wildlife rather than household-based surveys. Many of the results presented here support the conclusion that decreasing the demand for bushmeat on Bioko Island will be very difficult. For both Bubi and Fang, it is by far the most popular source of protein, even among those who eat bushmeat infrequently. Preferences for individual bushmeat species are different between ethnic groups, and a Fang preference for primate bushmeat is particularly noteworthy because primates are the most endangered species on Bioko Island. Outreach efforts in the form of a wildlife video shown frequently on national TV and a permanent nature center open to the public, did make an impression, but it was fleeting and did not prevent an increase in bushmeat preference, even primate bushmeat preference among the Fang, in the second survey. Although there were several signs of conservation outreach success, especially among university-educated citizens, an increased awareness of the bushmeat situation whether from the Ebola epidemic, from a decrease in market availability, or from conservation efforts did not lead to a decrease in bushmeat popularity as we had hoped. Instead, these efforts might have led to just the opposite, an increased desire for bushmeat in anticipation of it becoming banned.

Consequently, although we recognize the inherent limitations of supply-side controls, we also realize that preventing hunting, rather than changing bushmeat buying and eating habits, is the strategy that must be employed to preserve Bioko Island's larger forest mammals. Enforcing the boundaries and no-hunting policies of protected areas on Bioko Island would be a first step; enforcing the legislation that protects endangered species from hunting would be another step; and, enforcing the decree forbidding the hunting, sale and consumption of primates would be an additional step to protect the most endangered species.

Table 3.1a. Geographical location and number of completed questionnaires at each location in Survey Versions I and II in Bioko Island, Equatorial Guinea.

Location	Completed questionnaires (N)		
	Version 1	Version 2	Total
Urban			
Malabo (by neighborhood)			
UNGE	61	25	86
Santa Maria	16	1	17
Malabo II	64	7	71
Paraiso	9	4	13
Banapa	11	0	11
Old Malabo	42	14	56
Semu	59	21	80
Luba	2	17	19
Suburban			
Timbabe	1	0	1
Riocopua	8	0	8
Basupu Fish Town	0	7	7
Sampaka	6	0	6
Total Urban & Suburban	279	96	375

Table 3.1b. Geographical location and number of completed questionnaires at each location in Survey Versions I and II in Bioko Island, Equatorial Guinea

Location	Completed questionnaires (N)		
	Version 1	Version 2	Total
Rural (by village name)			
Bioko Norte			
Rebola	0	20	20
Baney	0	13	13
Basile Fang	0	12	12
Basile Bubi	0	14	14
Bilelipa	0	7	7
Bososo	0	18	18
Bantabare	0	12	12
Basacato del Este	0	23	23
Riaba	0	18	18
Basupu	5	0	5
Batoicopo	4	0	4
Bioko Sur			
Long Street	2	0	2
Arena Blanca	3	0	3
Fortune	0	18	18
Musola	0	17	17
Bombe	0	11	11
Moeri	0	9	9
Moka	3	38	41
Barrios Las Palmas	0	9	9
Ruiché	0	13	13
Belebu	0	12	12
Bocoricho	0	8	8
Bococo Drumen	0	7	7
Batete	6	18	24
Moraka Playa (Ureca)	13	0	13
North Camp (Ureca)	7	0	7
Total rural (Bioko Norte& Bioko Sur)	43	297	340
Grand total (urban & rural)	**322**	**393**	**715**

Table 3.2: Characteristics of respondents in Survey I, Survey II, and the combined surveys in Bioko Island, Equatorial Guinea

Characteristic	Version I (*N=322)*		Version II (*N=393)*		Combined Versions (N=715)	
	%	N	%	N	%	N
Survey Locations						
Urban	86%	279	24%	96	52.4 %	375
Rural	13%	43	75%	297	47.5 %	340
Gender						
Male	60%	194	60%	235	60 %	429
Female	40%	128	40%	158	40 %	286
Age cohorts						
<20	13%	42	11%	42	11.7 %	84
(20-29)	55%	177	26%	104	39.3 %	281
(30-39)	19%	61	17%	67	17.9 %	128
(40-49)	9%	29	15.2%	60	12.4 %	89
(50-59)	3%	10	13.2 %	52	8.6 %	62
(60-69)	1%	3	9.1%	36	5.4 %	39
>70	0	0	7.3%	29	4 %	29
N/A	0	0	0.7 %	3	0.4%	3
Ethnic groups						
Annobonese	3%	11	1.8%	7	2.5 %	18
Bubi	26%	83	62%	243	45.5 %	326
Fang	65%	208	34%	135	47.9 %	343
Rio Muni Coastal*	3%	10	2%	7	2.3 %	17
Other	3%	10	0.2%	1	1.5 %	11
Education levels (*N=381)*						
None	n/a	n/a	2%	8	1.1 %	8
Primary	n/a	n/a	19%	73	10.2 %	73
Secondary	n/a	n/a	59%	225	31.4 %	225
Vocational	n/a	n/a	6%	23	3.2 %	23
University	n/a	n/a	13%	52	7.4 %	52

** Rio Muni Coastal groups include respondents who identified themselves as Combe, Ndowe, Bujeba and Bisio*

Table 3.3: Bushmeat protein preferences versus location, gender and ethnicity in both version I and version II, Bioko Island, Equatorial Guinea

Food item	Version 1 Urban (N= 279) Rural (N= 43) Male (N=194) Female (N=128)	Version II Urban (N= 96) Rural (N= 297) Male (N=235) Female (N=158)	*AICs (saturated model** vs reduced model†)	Interactive effect††	Main effects***
Bushmeat protein preferences (location)			AICs (29.0 vs 37.1)	P<0.001	p<0.001
Urban	57% (n=167)	69%(n= 63)			
Rural	52% (n= 15)	73% (n=215)			
Bushmeat protein preferences (gender)			AICs (30.4 vs 31.4)	p= 0.06	p =0.19
Male	53% (n= 104)	73% (n= 172)			
Female	60% (n= 78)	67% (n=106)			
Bushmeat protein preferences (ethnicity)			AICs (29.5 vs 27.6)	p= 0.771	p =0.188
Fang	59% (n=125)	73% (n= 99)			
Bubi	53% (n= 44)	69% (n=169)			

**AIC=Akaike Information Criterion. Its values sever as reference points for the selection of the correct model.*

***Saturated model refers to model with main effects (location, gender, ethnicity, survey version) and the interaction (either ethnicity or location with survey version).*

†Reduced model refers to refers to model without the interaction term and only deals with main effects (gender, ethnicity, location, survey version).

††Interactive effect refers to the interaction and the p-value of which is reported. It was also compared to an ANOVA test using a Chi-squared goodness of fit test.

****The predicted probabilities of the selected models are expressed as percentages in the table*

Table 3.4: Preferences of domestic sources of protein across ethnicity and locations Versions I and II, Bioko Island, Equatorial Guinea

Food item	Version 1 Fang (N= 208) Bubi (N= 83) Urban (N= 279) Rural(N= 43)	Version 2 Fang (N=135) Bubi(N=243) Urban(N= 96) Rural (N= 297)	*AICs (saturated model vs reduced model)	Interactive effect**	Main effects***
Beef protein preferences (ethnicity)			AICs(21.2 vs 26.3)	p= 0.02	p=0.67
Fang	4% (n= 10)	5% (n= 7)			
Bubi	6% (n= 5)	0.4% (n= 1)			
Chicken protein preferences(ethnicity)			AICs(26.7 vs 25.1)	p= 0.525	p= 0.44
Fang	14% (n= 28)	9% (n= 14)			
Bubi	16% (n =15)	11% (n= 26)			
Fish protein preferences (ethnicity)			AICs(27.1 vs 25.2)	p= 0.75	p =0.422
Fang	15% (n = 32)	11% (n= 15)			
Bubi	17% (n= 14)	13% (n= 34)			
Beef protein preferences (location)			AICs(23.0 vs 23.0)	p= 0.143	p =0.05
Urban	4% (n= 12)	4% (n =4)			
Rural	11% (n= 5)	3% (n= 11)			
Fish protein preferences (location)			AICs(27.0 vs 32.2)	p< 0.001	p <0.0001
Urban	13% (n= 39)	12% (n= 12)			
Rural	39% (n= 17)	12% (n= 37)			
Chicken protein preferences (location)			AICs(26.1 vs 24.1)	p= 0.956	p = 0.271
Urban	15% (n=12)	13% (n= 4)			
Rural	11% (n= 5)	10% (n=11)			

**AIC=Akaike Information Criterion. Its values sever as reference points for the selection of the correct model.*

***Interactive effect refers to the interaction and the p-value of which is reported. It was also compared to an ANOVA test using a Chi-squared goodness of fit test.*

****The predicted probabilities of the selected models are expressed as percentages in the table.*

Table 3.5. Preferences of specific bushmeat species and species groups for food by ethnicity in Survey Version I and Version II, Bioko Island, Equatorial Guinea

Food item	Version 1 Fang(N= 208) Bubi(N= 83)	Version 2 Fang (N=135) Bubi (N=243)	*AICs (saturated model vs reduced model)	†Interactive effect	Main effects of ethnicity††
Primate bushmeat protein preferences (ethnicity)			AICs (22.3 vs 20.7)	p= 0.50	p<0.0001
Fang	8.3% (n= 17)	16.6% (n= 23)			
Bubi	0.7% (n= 1)	1.4% (n= 3)			
Duiker bushmeat protein preferences(ethnicity)			AICs (28.9 vs 27.3)	p=0.5183	p<0.0001
Fang	21%(n= 43)	16% (n= 24)			
Bubi	48%(n =42)	40% (n= 97)			
Pangolin bushmeat protein preferences (ethnicity)			AICs (24.6 vs 23.3)	p=0.385	p<0.0001
Fang	13% (n = 28)	18% (n= 26)			
Bubi	2.3% (n= 3)	3.3% (n= 7)			
Giant pouched rat bushmeat protein preferences (ethnicity)			AICs (22.8 vs 20.9)	p<0.849	p<0.001
Fang	1.5% (n= 3)	4.2% (n =6)			
Bubi	4.5% (n= 4)	12% (n= 29)			
Porcupine bushmeat protein preferences (ethnicity)			AICs (28.1 vs 39.8)	p<0.0001	p<0.0001
Fang	32% (n= 68)	23% (n =27)			
Bubi	10% (n= 9)	20% (n= 58)			

**AIC=Akaike Information Criterion. Its values serves as reference points for the selection of the correct model.*

†Interactive effect refers to the interaction and the p-value of which is reported. It was also compared to an ANOVA test using a Chi-squared goodness of fit test.

††The predicted probabilities of the selected models are expressed as percentages in the table.

Table 3.6. Characteristics of consumers regarding location of last bushmeat consumed across geographical location, gender, ethnicity, education and age cohorts, Bioko Island, Equatorial Guinea

Characteristics of consumers	Version II		Total	Statistical comparison
	Home	Away from home	% N(393)	
Location of last bushmeat consumed by geographical location				(x^2=10.3, df=1, p<0.001)
Rural	85.2 % (220)	14.7% (38)	65.6% (258)	
Urban	68% (54)	31.6% (25)	20.1% (79)	
Location of last bushmeat consumed by gender				(x^2=4.78, df=1, p <0.01)
Male	78% (164)	21% (46)	53.4% (210)	
Female	87% (123)	12% (17)	35.6% (140)	
Location of last bushmeat consumed by ethnicity				(x^2=0.33, df=1, p=0.561)
Fang	84.4 % (98)	15.5% (18)	29.5% (116)	
Bubi	81.2% (169)	18.7% (39)	52.9% (208)	
Location of last bushmeat consumed by education level				(x^2=12, df=4, p <0.01)
None	100% (7)	0% (0)	1.7% (7)	
Primary	82.7% (48)	17.2% (10)	14.7% (58)	
Secondary	86.9% (167)	13% (25)	48.8% (192)	
Vocational	80.9% (17)	19% (4)	5.3% (21)	
University	65% (27)	34% (14)	10.4% (41)	
Location of last bushmeat consumed by age cohorts				(x^2=13.8, df=4, p<0.001)
<20	81.5% (31)	18.4% (7)	9.6% (38)	
20-29	69.8% (65)	30.1% (28)	23.6% (93)	
30-39	83.6% (51)	16.3% (10)	15.5% (61)	
40-49	85.9% (49)	14% (8)	14.5% (57)	
>50	89.7% (88)	10.2% (10)	24.9% (98)	

Table 3.7. Categories of wildlife not consumed due to tradition or taboo identified by male and female Fang and male and female Bubi respondents in Version II (N=194), Bioko Island, Equatorial Guinea.

	Fang (N=110)		Bubi (N=84)	
	Male (N=52)	Female (N=58)	Male (N=53)	Female (N=31)
Primates	28%	22%	41%	29%
Ungulates	9.6%	6.8%	18%	12%
Reptiles	30%	51%	33%	41%
Other	30%	18%	5.6%	16%

*****The term "ungulates" includes (duikers, elephants, and goats)

Table 3.8 Attitudes towards wildlife conservation among respondents on Bioko Island (N=393), Equatorial Guinea.

Opinions about wildlife conservation	Version II	Statistical comparison
Wildlife protection from overhunting(Age cohorts)		(x^2 = 29.3, df=4, p<0.0001)
<20	90% (n= 42)	
(20-29)	84% (n= 92)	
(30-39)	75% (n= 60)	
(40-49)	56% (n= 57)	
(50-59)	55% (n= 49)	
Wildlife protection from overhunting(Education levels)		(x^2 = 10.7, df=4, p=0.029)
None	50% (n= 6)	
Primary	59% (n= 62)	
Secondary	73% (n= 215)	
Vocational	69% (n= 23)	
University	84% (n= 52)	
Wildlife protection from overhunting(Locations)		(x^2 = 12, df=1, p<0.0001)
Urban	88% (n= 87)	
Rural	68% (n= 273)	
Affordable fee to protect biodiversity (Age cohorts)		(x^2 = 13, df=4, p<0.0001)
<20	92% (n= 38)	
(20-29)	90% (n= 84)	
(30-39)	83% (n= 53)	
(40-49)	72% (n= 47)	
(50-59)	72% (n= 44)	
Affordable fee to protect biodiversity (Locations)		(x^2 = 10, df=1, p<0.001)
Urban	89% (n= 85)	
Rural	71% (n= 263)	
Affordable fee to protect biodiversity (Education levels)		(x^2 = 11.1, df=4, p=0.025)
None	50% (n= 8)	
Primary	68% (n= 61)	
Secondary	75% (n= 207)	
Vocational	95% (n= 20)	
University	86% (n=43)	

Table 3.9: Respondent educational levels within each reason given for protecting wildlife with educational levels expressed as a percentage of the total respondents selecting each reason, Bioko Island, Equatorial Guinea.

	Educational Level				
Reason for protecting wildlife	None	Primary	Secondary	Vocational	University
Hunt-trap for food (N=24)	15 %	23 %	50 %	7 %	4 %
Hunt-trap sell for income (N=23)	0 %	0 %	77 %	4.5 %	18 %
Tourists to see (N=77)	3.7 %	6 %	54 %	7 %	28 %
Natural heritage preservation (N=84)	0 %	18 %	56 %	4 %	19 %
Biodiversity preservation (N=37)	0 %	21 %	72 %	0 %	0 %
No opinion (N=6)	0 %	16 %	83 %	0 %	0 %

Table 3.10: LGLM results for public awareness questions from version I and II: a) source used (EGTV vs other) to view the Drill fill documentary by location; b) Drill project documentary viewers by location; c) knowledge about the MWC by location; d) source used (EGTV vs other) to learn about the Moka Wildlife Center by location, Bioko Island, Equatorial Guinea.

Measure	Version I	Version II	*AICs (saturated model vs. reduced model)	**Interactive effect	***Main effect of location
Source used to view the Drill film by location (EGTV vs Other)			(23.1 vs 23.9)	p =0.076	p =0.761
Urban	89 % (n=147)	80 % (n=40)			
Rural	86 % (n=20)	93 % (n=103)			
Drill film viewers by location (urban vs rural)			(29.1 vs 28)	p =0.346	p <0.01
Urban	63% (n=168)	53% (n=49)			
Rural	51% (n=24)	41% (n=113)			
Knowledge about the MWC by location (urban vs rural)			(28.7 vs 27.9)	p =0.275	p >0.05
Urban	71% (n=190)	67% (n=63)			
Rural	62% (n=28)	57% (n=157)			
Source used to learn about the MWC by location (EGTV vs Other)			(27.2 vs 29.3)	p =0.04	p =0.05
Urban	55% (n=103)	37 % (n=22)			
Rural	35% (n=10)	44 % (n=63)			

**AIC=Akaike Information Criterion. Its values serves as reference points for the selection of the correct model.*

***Interactive effect refers to the interaction and the p-value of which is reported. It was also compared to an ANOVA test using a Chi-squared goodness of fit test.*
****The predicted probabilities of the selected models are expressed as percentages in the table.*

Table 3.11: Distribution of respondents across urban and rural areas: version I and version II compared to a census of Equatorial Guinea conducted by the government and released in 2015**.**

Location	Version I (N=322)		Version II (N=393)		Government Census* 2015	
	N	Percentage	N	Percentage	N	Percentage
Urban	288	89	270	69	287,000	86
Rural	34	11	123	31	47,461	14
Total	**322**	**100**	**393**	**100**	**334,461**	**100**

**Data extracted from the 2015 Equatorial Guinea government census report*

Table 3.12: Distribution of age cohorts in version I versus version II (Bioko Island, Equatorial Guinea) and comparison with neighboring country Cameroon.

	Survey I (N=322)	Survey II (N=393)	Cameroon country data* N= 10,984,000
<20 yrs.	13% (n= 42)	11% (n= 42)	22%** (n= 2,416,000)
20-29 yrs.	55% (n= 177)	26% (n= 104)	34% (n= 3,734,000)
30-39 yrs.	19% (n= 61)	17% (n= 67)	21% (n= 2,306,000)
40-49 yrs.	9% (n= 29)	15 % (n= 60)	14% (n= 1,537,000)
50-59 yrs.	3% (n= 10)	13% (n= 52)	8% (n= 878,000)

**Data about Cameroon's actual age distribution was extracted from the Open Data for Africa website (Lapitskiy 2015): http://cameroon.opendataforafrica.org/rfdefze/census-data*
***It includes age cohorts between 15-19 yrs. old*

Table 3.13: Status of education in Equatorial Guinea from July 3rd, 1964, date in which the country was granted an autonomous status by Spain*.

Education level	Nº of schools	Location	Length
Primary school categories			
Basic primary school	N/A	Urban/rural areas	5 years
Upper primary	15	Malabo, Bata and district headquarters	2 years
Secondary school categories			
Native high school	1	Malabo	5
Official high school	2	Malabo and Bata	6
Vocational education			
Vocational School La Salle	1	Bata	3-6 years
Agricultural training	1	Malabo	2 years
Arts and administrative skills (carpentry, plumbing, mechanic. Etc.)	1	Malabo	2 years
University			
University and college	None	_____	_____

**Information in the table was extracted from (Borikó 1989)*

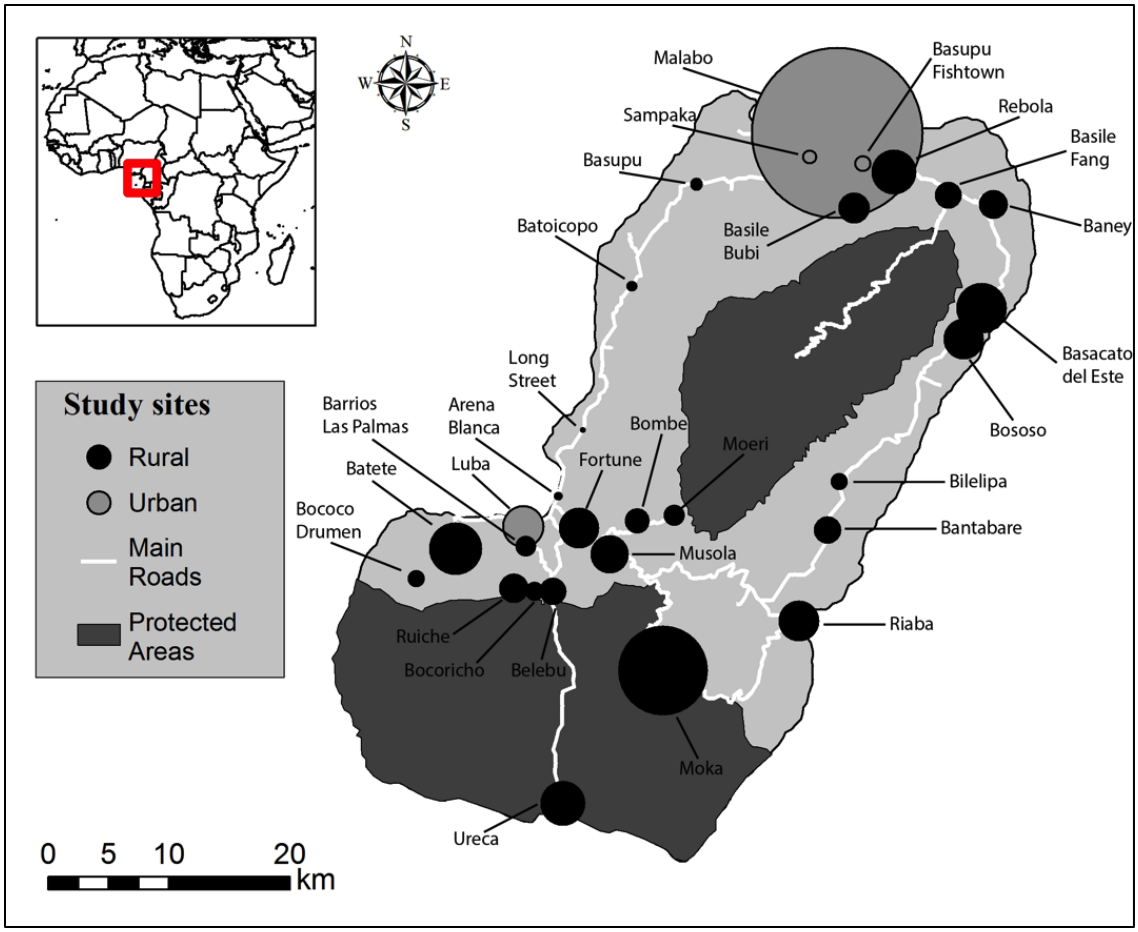


Figure 3.1. Geographical locations of data collection across Bioko Island, with each circle representing the combined number of questionnaires administered in each site in both surveys version I and version II.

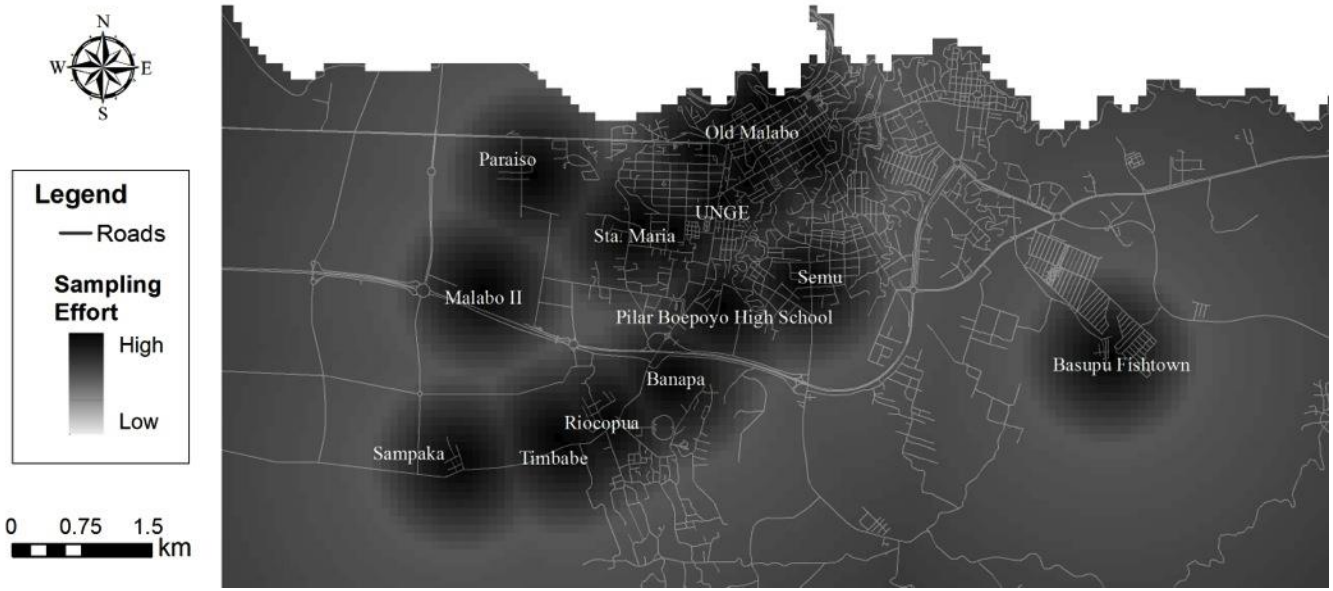


Figure 3.2. Distribution of sampling effort across the city of Malabo in both surveys version I and version II, showing city neighborhoods and suburban areas

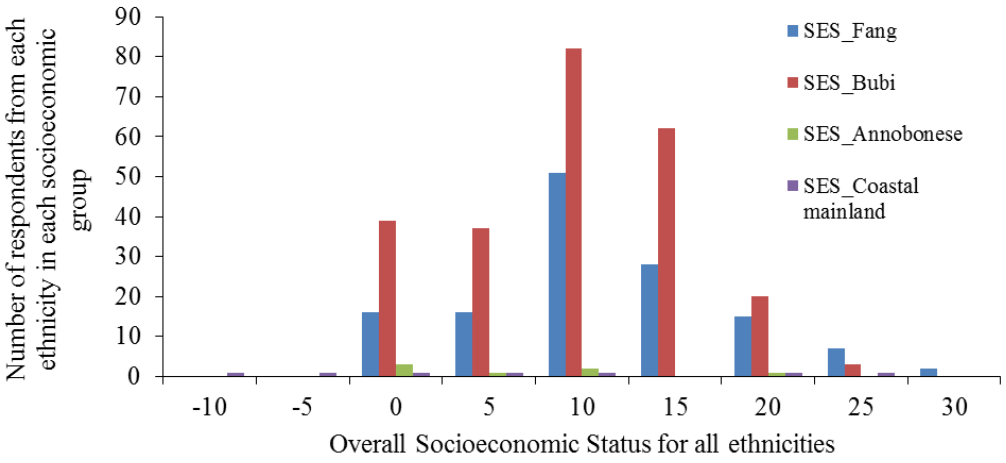


Figure 3.3: Distribution of socioeconomic status (SES) scores across the four major ethnicities represented on Bioko Island, Equatorial Guinea

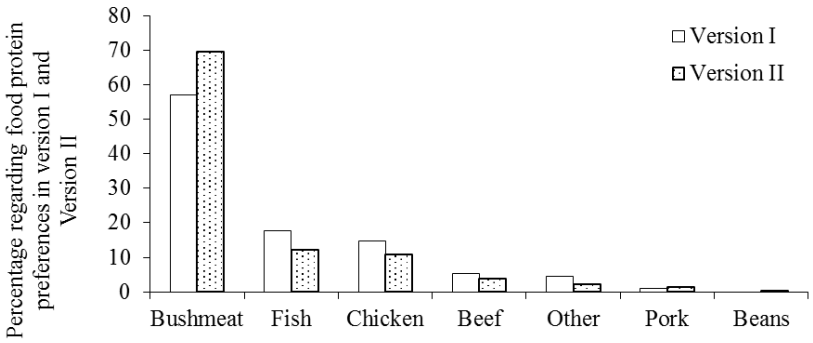


Figure 3.4: Overall food protein preferences of all respondents in both surveys Version I (N=322) and Version II (N=393), Bioko Island, Equatorial Guinea.

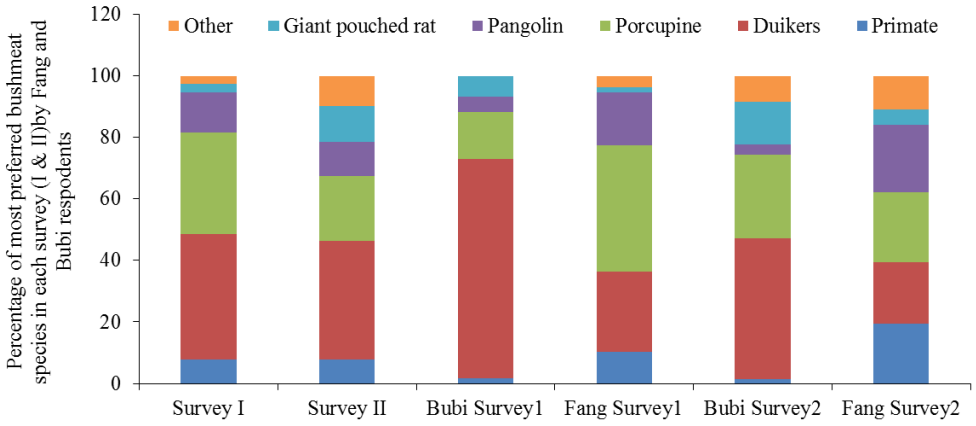


Figure 3.5: Overall list of most selected bushmeat species in version I and version II; Bubi and Fang in both version I and version II, Bioko Island, Equatorial Guinea.

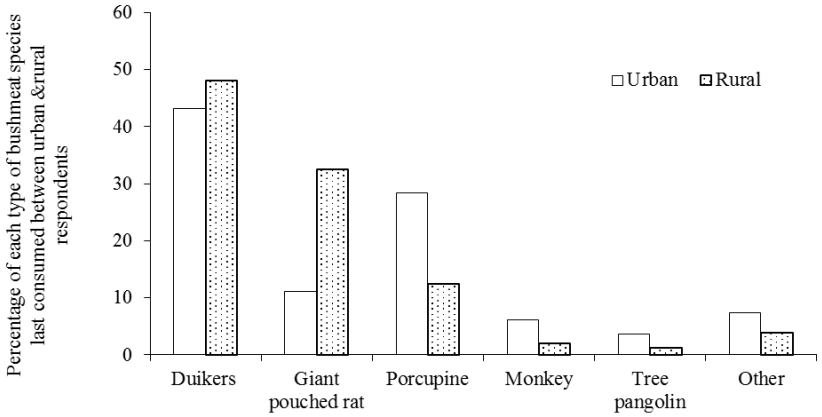


Figure 3.6: Bushmeat type last consumed among urban and rural respondents (Version II only), Bioko Island, Equatorial Guinea.

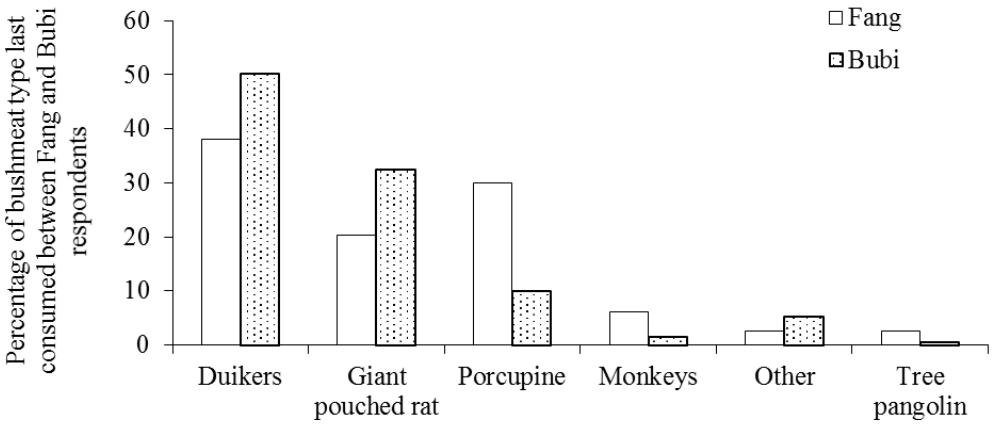


Figure 3.7: Reported bushmeat type last consumed across Fang and Bubi respondents, Bioko Island, Equatorial Guinea.

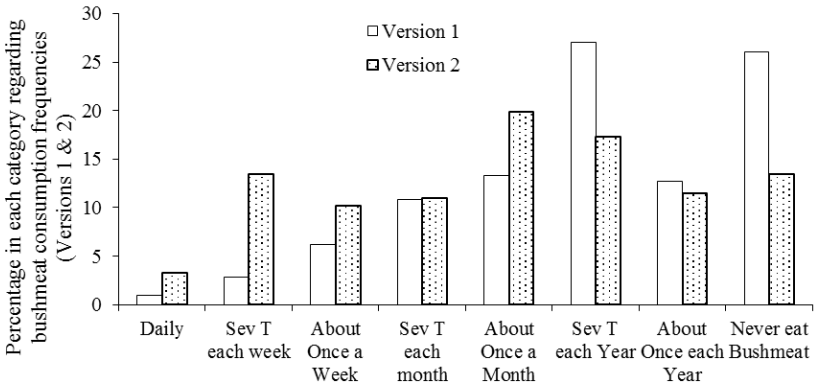


Figure 3.8: Overall bushmeat consumption frequencies in both version I and version II, Bioko Island, Equatorial Guinea.

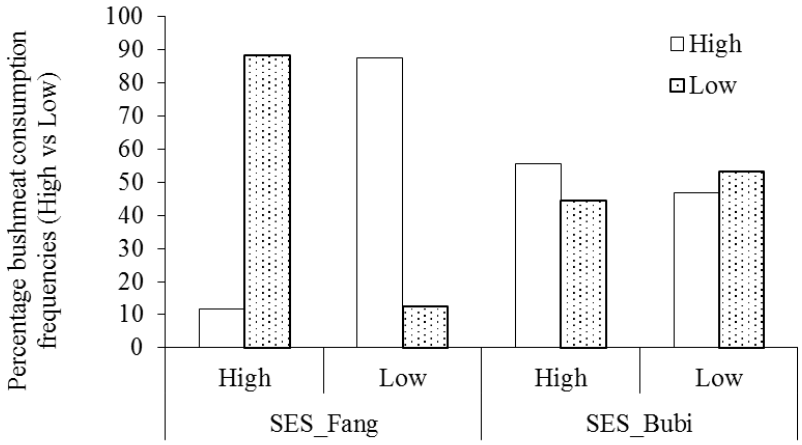


Figure 3.9: Socioeconomic statuses (high and low) versus bushmeat consumption frequencies (high and low) for Fang and Bubi respondents. Data reported as percentages in each class, Bioko Island, Equatorial Guinea.

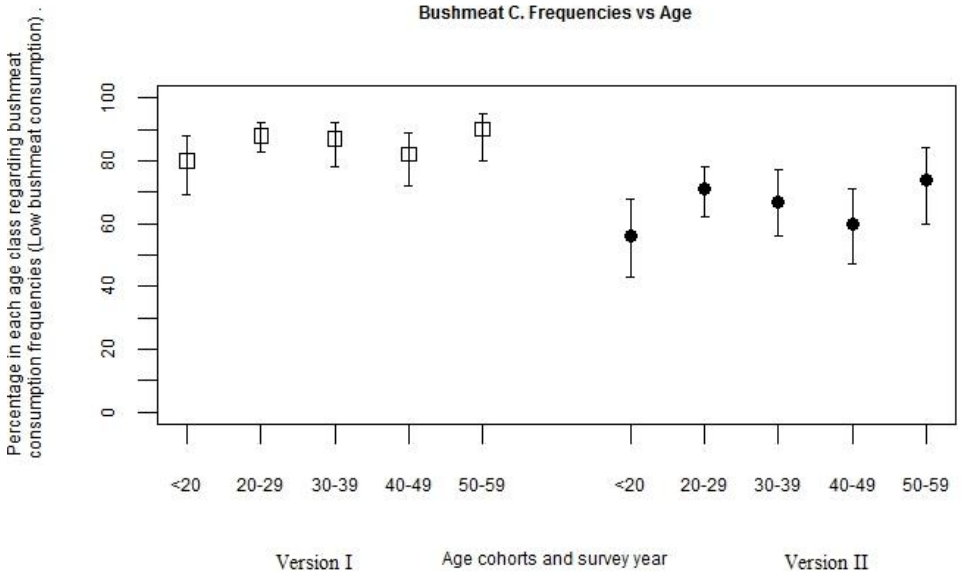


Figure 3.10: Lowest bushmeat consumption frequencies (once per year or never) across age cohorts in Version I and Version II, Bioko Island, Equatorial Guinea. Error bars represent the confidence intervals.

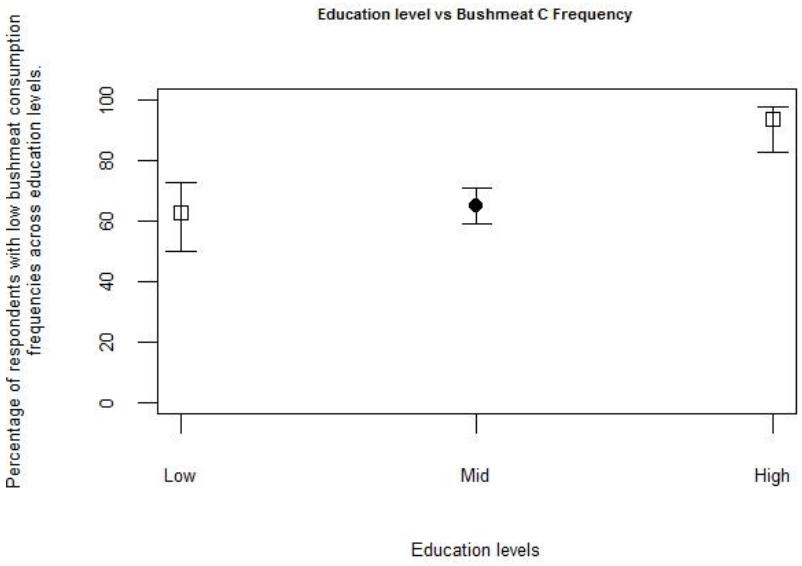


Figure 3.11: Bushmeat consumption frequencies across education levels. Low education level (none and primary); middle education level (secondary and vocational); high education level (university). High bushmeat consumption frequencies (approximately once per week or more) and low bushmeat consumption frequencies (approximately once per year or never), Bioko Island, Equatorial Guinea. Error bars represent the confidence intervals.

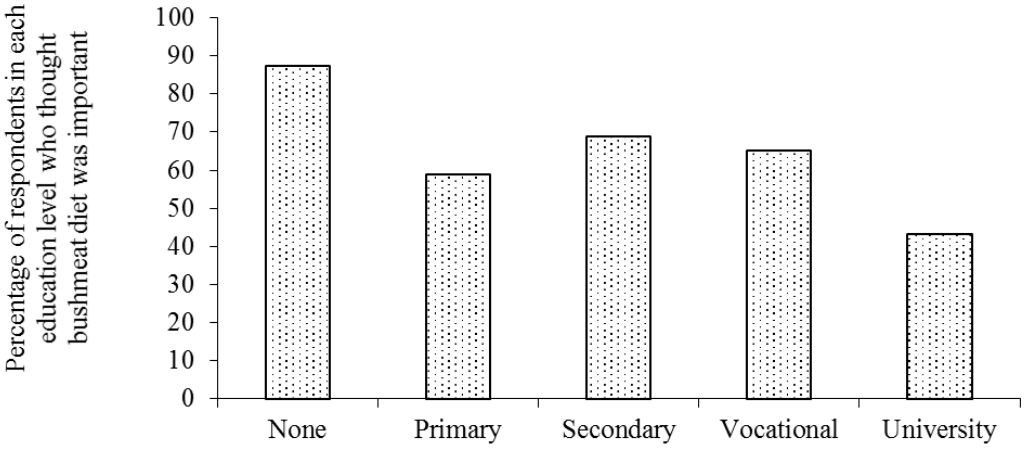


Figure 3.12: Percentage of respondents in each educational category who believed that bushmeat fulfilled important dietary needs, Bioko Island, Equatorial Guinea.

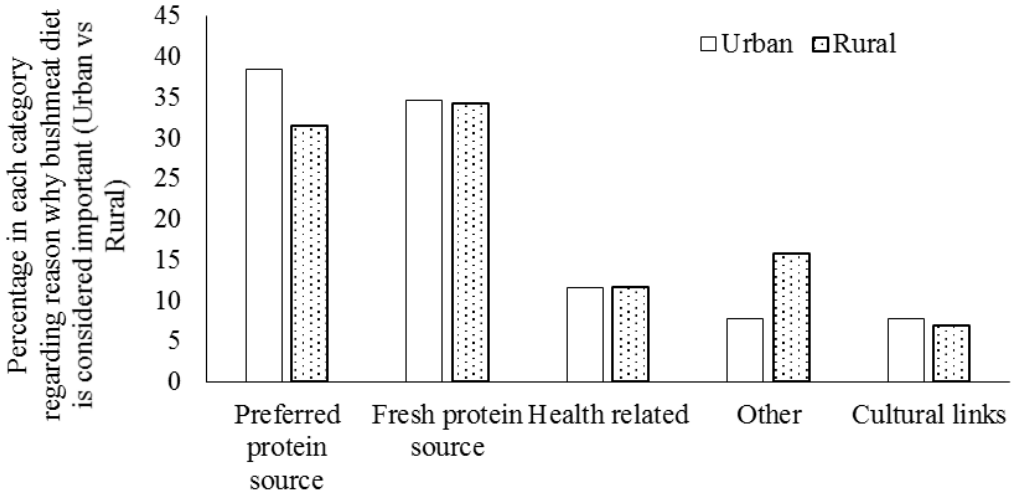


Figure 3.13: Percentage of respondents giving a particular reason why bushmeat fulfilled an important dietary need, Bioko Island, Equatorial Guinea.

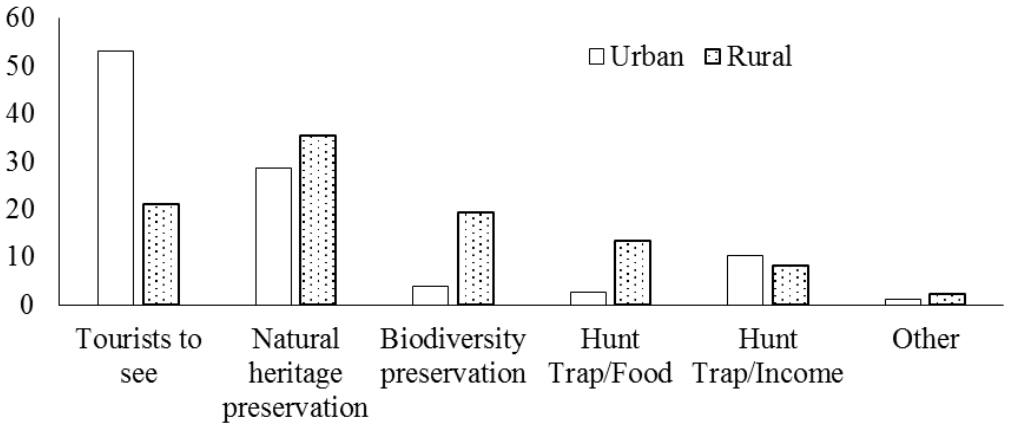


Figure 3.14: Reasons for protecting wildlife from overhunting across urban and rural respondents, Bioko Island, Equatorial Guinea.

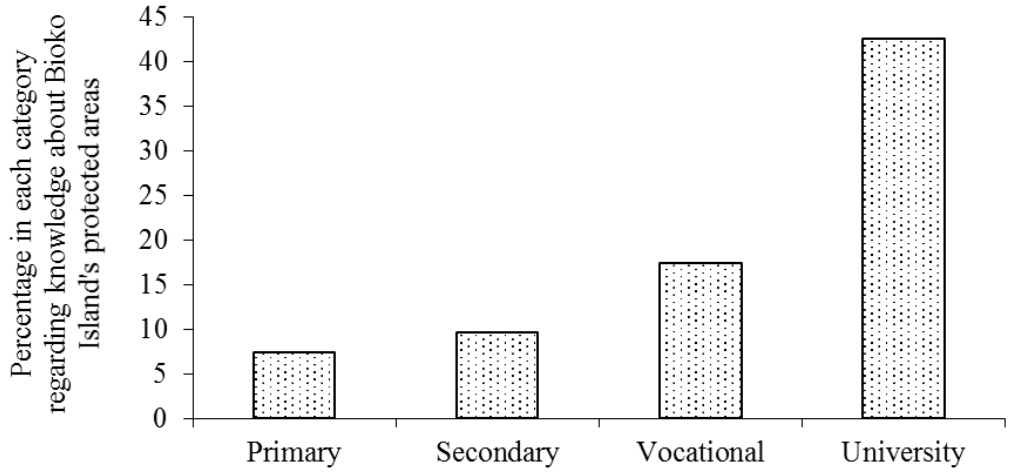


Figure 3.15. Knowledge about the number of protected areas found in Bioko across education levels, Bioko Island, Equatorial Guinea.

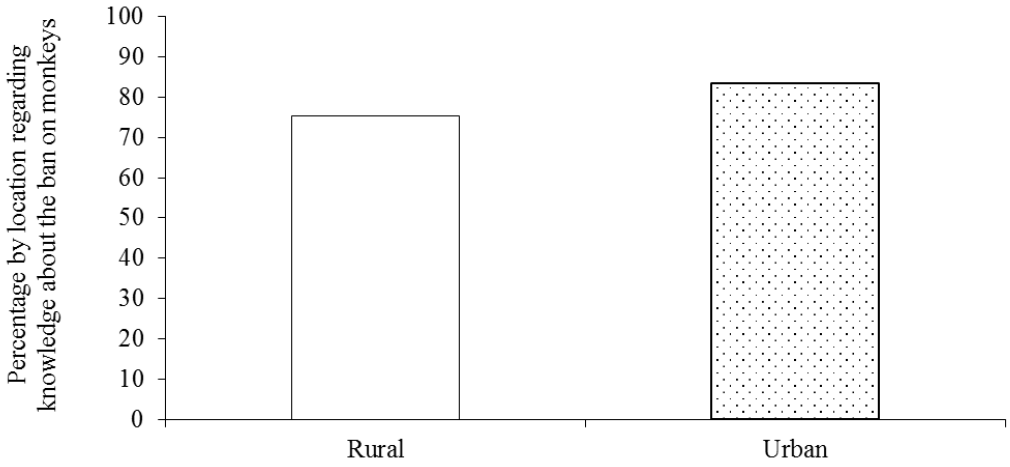


Figure 3.16. Location versus knowledge about the decree on monkeys, Bioko Island, Equatorial Guinea.

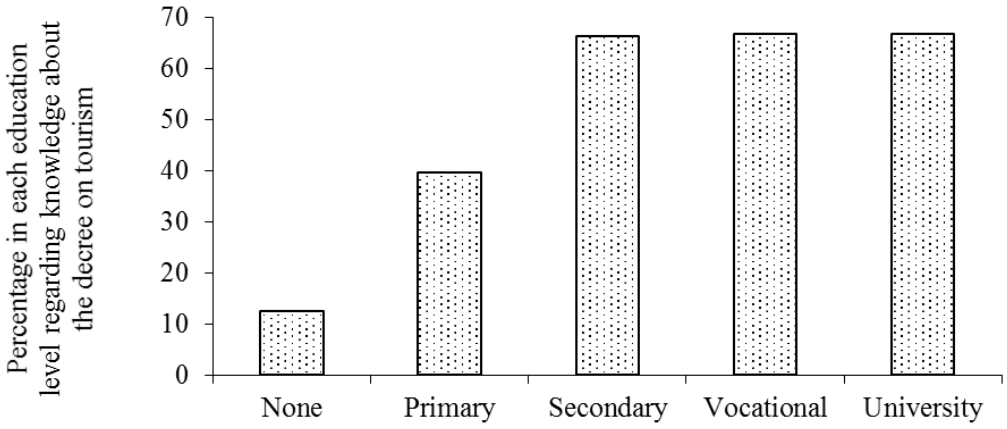


Figure 3.17. Respondents who knew about the decree on tourism across education levels, Bioko Island, Equatorial Guinea.

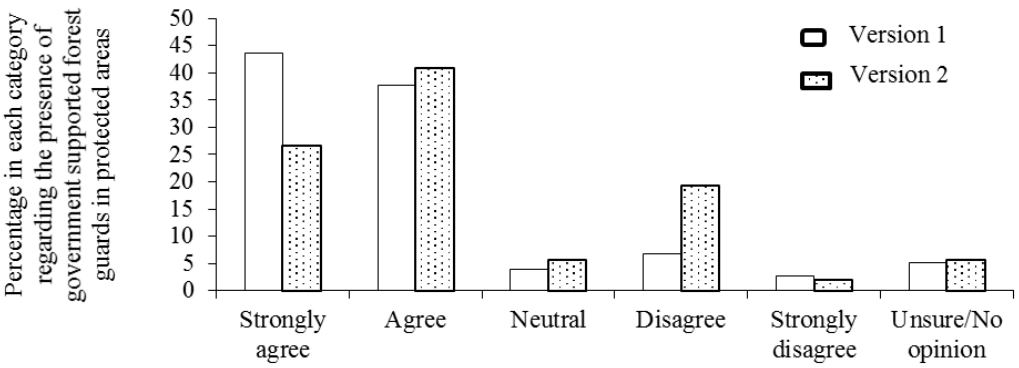


Figure 3.18: Opinions about the importance of having a government supported body of forest guards in the protected areas (version I & version II), Bioko Island, Equatorial Guinea.

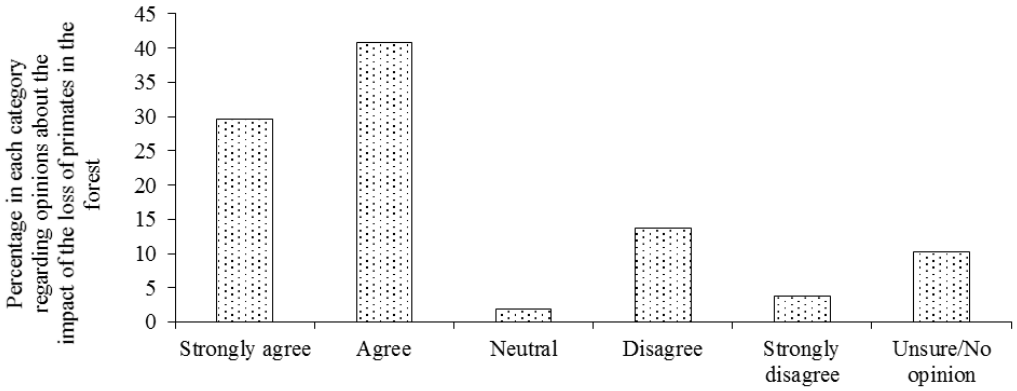


Figure 3.19: Opinions about the loss of primates in the forests and its impact on the ecosystem, Bioko Island, Equatorial Guinea.

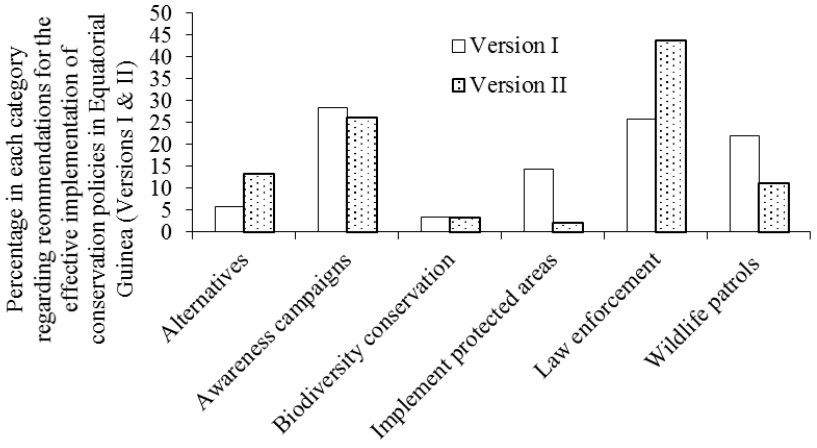


Figure 3.20: Recommendations towards the improvement of conservation policies, Bioko Island, Equatorial Guinea.

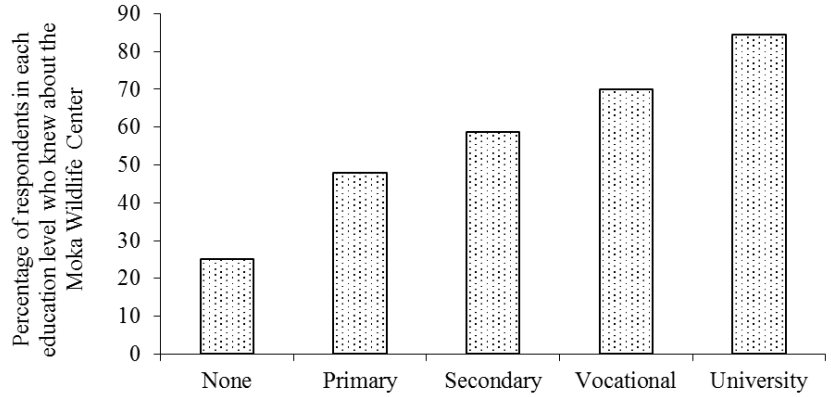


Figure 3.21: Respondents aware of the existence of the Moka Wildlife Center across education levels, Bioko Island, Equatorial Guinea.

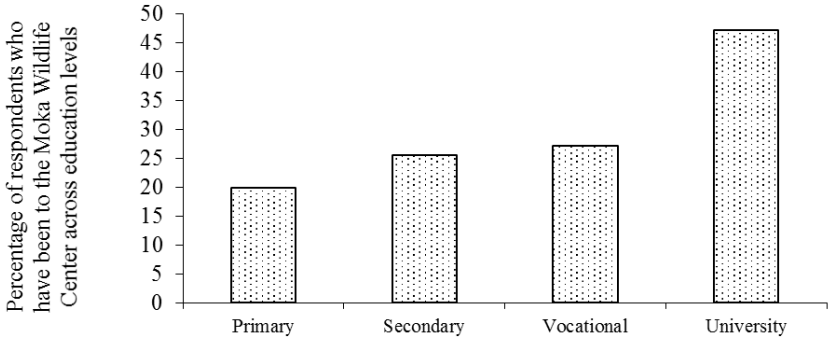


Figure 3.22: Respondents who have made a visit to the Moka Wildlife Center versus education levels, Bioko Island, Equatorial Guinea.

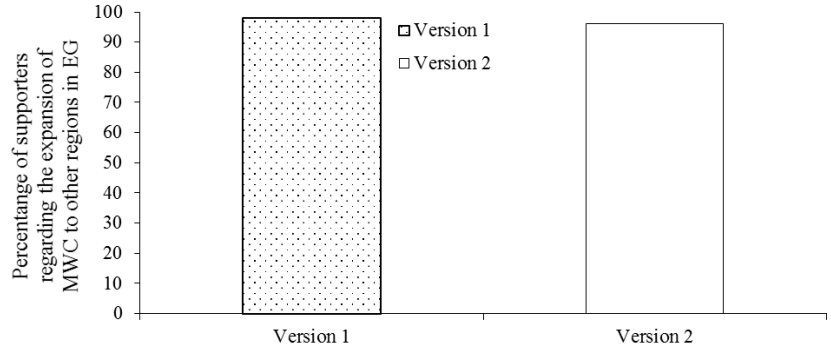


Figure 3.23: Expansion of the Moka Wildlife Center to other regions in Equatorial Guinea (version I and II).

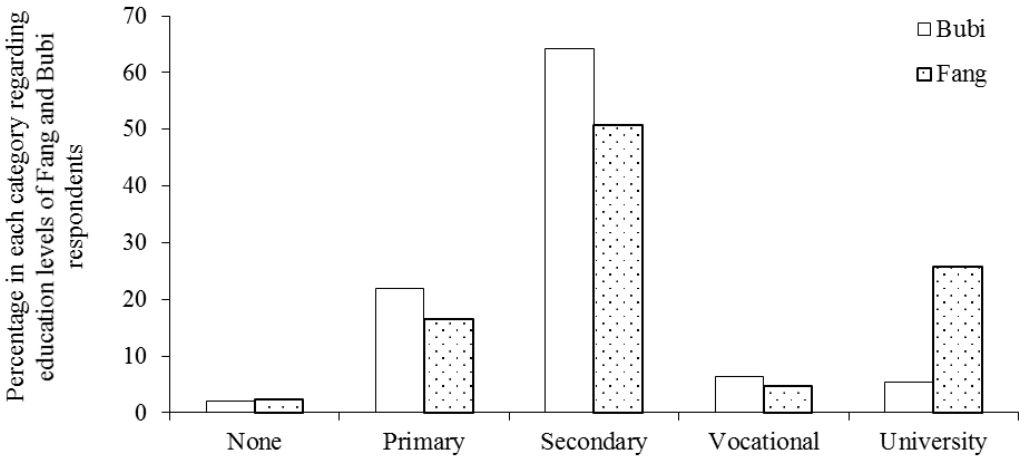


Figure 3.24: Education levels of Fang and Bubi respondents, Bioko Island, Equatorial Guinea.

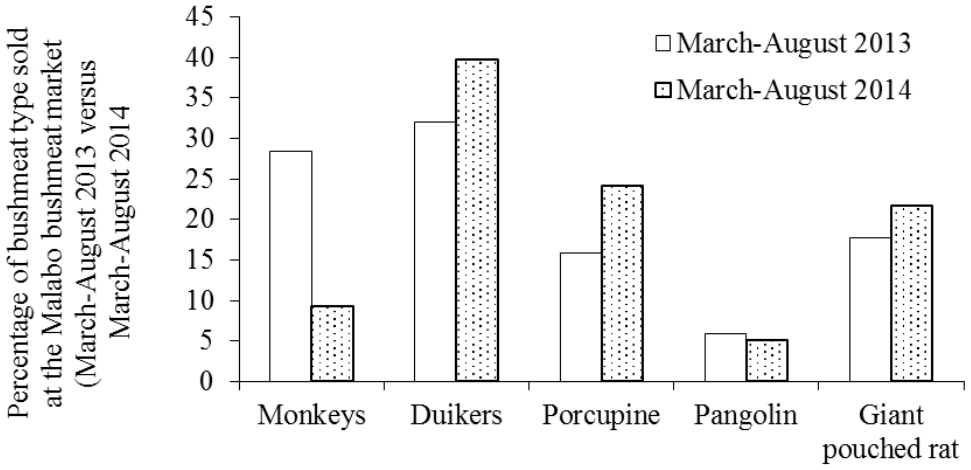


Figure 3.25: A comparison of the five most commonly sold bushmeat categories at the Malabo bushmeat Market over six month period March through August 2013 versus March through August 2014. There were significant differences in carcass numbers (x^2=542.6, p<0.0001): primate carcasses decreased in 2014 (28 vs 9.3%); all the other bushmeat animals increased in 2014 duikers (32 vs 39%), porcupine (15 vs 24 %) and giant pouched rat (17 vs 21%). Data collected by BBPP and provided by Drew Cronin, Bioko Island, Equatorial Guinea.

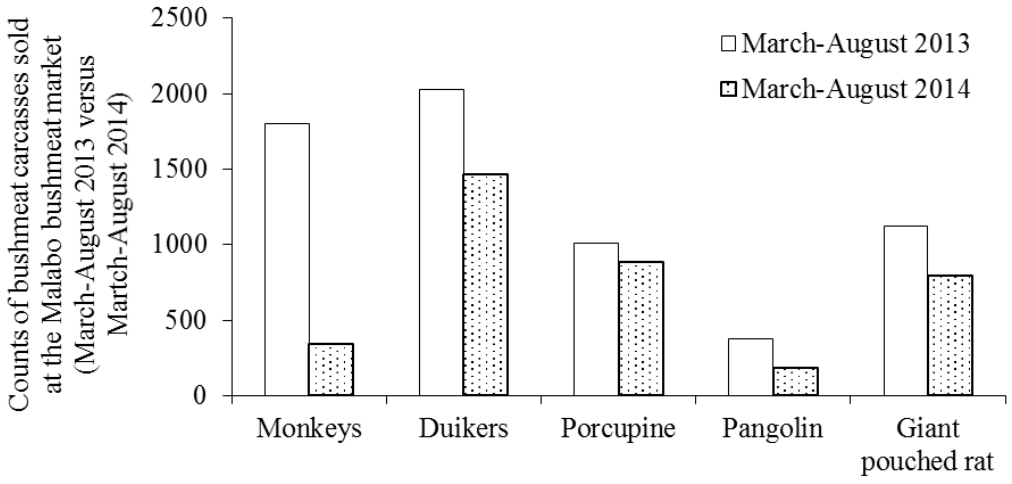


Figure 3.26: A comparison of carcass numbers for the five most commonly sold bushmeat categories in the Malabo market between two six month periods: March through August 2013 and March through August 2014 (x^2=542.6, p<0.0001), Bioko Island, Equatorial Guinea.

Chapter 4. Bushmeat preference and conservation awareness in Cameroon with comparisons to Bioko Island

Introduction:

The bushmeat crisis extends throughout tropical Africa and efforts to protect wildlife from unsustainable, often commercial, hunting have met with limited success (Willcox & Nambu 2007; Macdonald et al. 2012; Lindsey et al. 2013). Bioko Island Equatorial Guinea, has provided an especially illuminating case study (Cronin et al. 2015) and Chapter 3 of this dissertation). Not only are prices for bushmeat higher than elsewhere in the Gulf of Guinea region (Reid et al. 2005; Wilkie et al. 2005), but also the preference for bushmeat is greater than elsewhere (Carvalho et al. 2015). Awareness campaigns are acknowledged by the citizens (Chapter 3), but have not reduced the preference for bushmeat.

For insight into the extreme situation on Bioko Island, we decided to repeat our questionnaire on the nearby mainland in Cameroon, whose more coastal, forested regions share a common biogeographical profile with Bioko Island. But even though Cameroon is the closest mainland to Bioko Island and shares a common border with Rio Muni, it has a very different sociopolitical history.

Unlike Bioko Island and the country of Equatorial Guinea which together have only a handful of ethnic groups, Cameroon has more than 250 distinct ethnic groups. While some of these ethnic groups are clearly defined and easily identified by linguistic traditions (the Fang, a major group among the Beti-Pahouin people, all of whom speak a mutually-comprehensible Bantoid language), others are less clearly defined (the Badjoué, a smaller group who speak a Makaa-Njyemin language) and some are entirely unclear (the Tikar, a group of mixed ethnicities, homelands, and languages). However, these ethnic groups were the ones most commonly claimed by the respondents in our survey and their characteristics are typical of groups in the very diverse country of Cameroon:

> *The Fang:* The Pahouin people occupy most of southern Cameroon, starting from the Sanaga River and expanding into regions of mainland Equatorial Guinea and Gabon (Nelson et al. 1974). Their origin is not entirely clear. Some scholars state that the Pahouin people were expelled from their original territory in the northeast savannah region of Cameroon when they came in contact with the Fulani, which made them migrate southwards towards the ocean (Nelson et al. 1974). However, based on linguistic evidence it appears that the Fang originated from the banks of the Sanaga River and migrated into areas of the upper Ntem and Woleu rivers in northern Gabon and Rio Muni and this expansion happened

in the fourteen century (Vansina 1990b). Even though there exist many subdivisions among the Pahouin people, there are only three major groups Beti, Boulou and Fang (Nelson et al. 1974). As in the rest of Bantu groups, the Pahouin practice hunting and farming; some of their most important crops are maize and cassava (Nelson et al. 1974).

Badjoué: The Badjoué (often Dwe'e, or Bajwe or Badwe'e) people are a relatively small ethnic group of about 30,000 people that are now settled in the southeastern part of Cameroon, near the Dja Forest reserve. They speak Koozime, a Makaa-Njyemin language (Beavon & Beavon 1983; Belibi et al. 2015). The Badjoué practice subsistence farming, fishing and bushmeat hunting (Tieguhong & Zwolinski 2009; Peh et al. 2011; Belibi et al. 2015). Groundnuts, coco-yam, cassava, maize, plantain and banana are some the crops cultivated by the Badjoué people. In addition, cocoa is raised by the Badjoué for profit only (Ashley et al. 2006)

Tikar: The Tikar people are a Bantu group living in the western highlands and grasslands regions of Cameroon (Nelson et al. 1974). It is said that Tikar people's original home range was near Tibati and Ngoundere, located in the northeast of their current territories. They started migrating southwards in different migration waves in the eighteen century (Nelson et al. 1974). Presently, the Tikar are spread across many villages, which are in turn led by kings; the largest ones are Bankim, Ngambe and Nditam (Stelzig 2009). Tikar are also found in the northwestern region of Cameroon (LeVine & Le Vine 1964). The Tikar practice subsistence agriculture and some of their most important crops are

maize, millet and plantains; and coffee is considered the most important cash crop (Jeffreys 1964; Price 1985). They use palm oil and pepper for cooking (Price 1985). In addition, hunting and fishing are also part of the Tikar culture (Jeffreys 1964). Some of the harvested bushmeat and fish are smoked and exported to other regions of Cameroon (Jeffreys 1964). Lion, leopard, eagle and python were considered royal animals and were only consumed by certain members of the chiefdom family (Price 1985).

In the earliest years of European colonization, Bioko Island and Cameroon shared common experiences. Like Bioko Island, Cameroon was discovered in 1472 by the explorer Fernão do Pó on the expedition organized by Fernando Gomes, a Portuguese merchant, on a contract from the Portuguese king Alfonso V (DeLancey et al. 2010). In fact, the name of the country originated with Fernão do Pó's description of that section of the coast as an estuary abundant in shrimp (Portuguese: *camarão,*), which then became "Cameroon."

Again like Bioko Island, the British ruled the territories of Cameroon during most of the 1800's but then their colonial rulers became different. From the late 1800's until the first quarter of the 20th century Cameroon was under German influence. Germans had a stronger presence in coastal and southern inland areas, where they established a successful plantation industry, but they had very little influence in the areas of northern Cameroon (Ardener 1962).

After World War I Britain and France regained control of Cameroon, with Britain getting a small part along the Nigerian border ("Southern Cameroon" = present day

Northwest Region and Southwest Region), and France getting the rest of the country. In the 1950s, local political leaders from the British-dominated territory made unsuccessful attempts to create their own autonomous states by trying to cut ties with the Federation of Nigeria. These fruitless attempts resulted in the creation of other factions among the leaders, some of whom were in favor of splitting off from the Federation of Nigeria and unifying part of their territory with the French Trust territory (Ardener 1962).

In 1960, the French ruled territory was granted its independence and, Ahmadou Ahidjo, a nationalist, became its first President. In 1961, the southern part of British Cameroon and the newly independent French zone were unified lawfully, forming the Federal Republic of Cameroon. From there on, English and French were declared as the country's two official languages (Ardener 1962). In 1972, a new constitution was passed abolishing the Federation and recognizing a unitary state called the United Republic of Cameroon (CIA 2016).

The Republic of Cameroon is currently divided in ten regions (Figure **4.1**), but only two of these are English-speaking and the other eight are French-speaking (Ngefac 2010). For this reason, French continues as the dominant language in the country (Fonyuy 2010).

The multilingualism approach was a tool aimed at nation building (Rosendal 2008), but even today many Cameroonians remain skeptical about its success. This was especially true of those from the English speaking territories who believed their language and culture were being marginalized by the ruling French (Ngefac 2010). However, in recent years, given that English provides more opportunities in the globalized world than

French, there is a growing number of Cameroonian French speakers (politicians and students) with an increased interest in learning English (Fonyuy 2010).

With this study, I was interested in determining the demand for bushmeat among the citizens of Cameroon and their level of interest in other sources of protein, and compare the results of a similar questionnaire administered on Bioko Island to gain insight into factors (colonial history, ethnicity) that influence bushmeat demand. Similar studies have taken place in other countries of Africa. For example, Brashares et al (2011) explored interaction between bushmeat preference and other socioeconomic factors in four African countries, Ghana, Tanzania and Madagascar and Cameroon, reporting that a collapse in alternative livelihoods can lead to an increase in wildlife hunting and consumption (Brashares et al. 2011). Finally, I aimed to determine their awareness of biodiversity conservation strategies to control the loss of wildlife.

Methods:

I developed my survey using an anonymous, quantitative questionnaire (Creswell 2013). My questionnaire derived from another one, which I administered in urban and rural areas of Bioko Island, Equatorial Guinea in the summer of 2014. This study for Cameroon consisted of 34 questions that were basically unchanged, and 15 questions that were revised to reflect a new set of potential answers. Six questions relevant only to Bioko Island were eliminated from the questionnaire.

Upon the revisions, the final questionnaire was divided into eight sections:

- Personal information
- Personal and household assets
- Food preferences

- Knowledge about conservation laws and protected areas
- Knowledge about Cameroon's wildlife
- Opinions about the Central African Biodiversity Alliance and the Last Great Ape Organization
- Section for farmers and hunters only
- Section for bushmeat market vendors

Drexel University's Institutional Review Board approved the questionnaire prior to its administration (#1308002258A0020).

Survey procedure: The survey was administered in urban and rural areas across Cameroon. Our targeted subjects were a representative sample of citizens from Cameroon from different ethnicities, religions, gender, education levels, socioeconomic statuses and occupations. Respondents were recruited randomly in public places, university campuses, public markets, houses, public offices and highly traveled streets. Respondents had to be citizens of Cameroon and at least 17 years old.

Interview procedure: I trained two students, Kamogne Tagne Cedric Thibaut and Fadimatou Amadou, from the High Institute of Environmental Sciences (HIES) of Yaoundé, Cameroon, on how to administer the questionnaires. After the training, the two students, supervised by Mary Katherine Gonder, a professor from Drexel University who was in Cameroon at that time, administered a test questionnaire to the public.

In the process of administering questionnaires, the field assistants read them to participants, either in French or English to make sure everyone understood all details

about the study. The two census takers were fluent in both English and French, which are the two official languages of Cameroon.

Questionnaire administrators had their HIES student identification cards on lanyards, exposed to respondents. Also, official permits were obtained from the Ministry of Environment and Forests and each survey administrator had one with him to be shown to respondents.

The subjects who participated in our study were targeted randomly and they were informed about all aspects of the study before they became engaged in the interview process. Participants were read a consent form clearly communicating the goals of the research, its duration and anonymity, free choice of ending the survey at any time and leaving sensitive questions unanswered, emergency contact number and final use of research findings.

Not all people approached were willing to participate in our study. Those who opted out gave as their alleged reasons that they were uninterested, or busy, or felt uncomfortable with the questionnaire, including being suspicious. Refusals happened at different rates in both urban and rural areas. In rural areas, approximately 80% were willing to participate but in urban areas participation fell to approximately 60%.

During the administration of the questionnaire, participants either did not, or could not, answer some questions:

- *Personal information:* Incomplete information was given for three of the total 213 questionnaires.

- *Knowledge about protected areas in Cameroon:* Very few people were aware of the number of protected areas found in Cameroon, so I eliminated these questions from data analysis
- *Opinions about the Central African Biodiversity Alliance (CAB-Alliance) and the Last Grate Ape:* Very few people were aware of these conservation organizations, so I eliminated these questions from data analysis

Selection of locations: Questionnaires were only administered in urban and rural sites from three regions in Cameroon: Center; East; and, South (Figure **4.2**). These sites were selected for the following reasons:

- The Center Region, in addition to being the location of the capital, Yaoundé, is also the most populous region nationwide, having 19% of the entire country's population (Lapitskiy 2015).
- My two field assistants went to school and lived in Yaoundé so they could administer questionnaires to a diverse group of people (different ethnicities, origins, religions, occupations, socioeconomic statuses, language backgrounds, education levels, gender, etc.) during their free time on weekdays and on the weekends.
- Cattle ranching is largely restricted to drier parts of the country, the Far-North region, the North region, Adamawa region and the North-west region (Epule et al. 2014). Consequently, people from those drier, cattle-farming regions may depend more on meat supplied from domestic animals, especially cattle, and have less dependency on bushmeat for daily protein.

- The three regions Center, East and South have ecoregions composed of tropical rainforests and mangrove forests, similar to those on Bioko Island (Epule et al. 2014).

- Some of the ethnic groups from these three regions Center, East and South extend their homelands into neighboring countries. For example, the Fang ethnic group found across the Center, East and South of Cameroon, is also well represented in Equatorial Guinea and Gabon (Vansina 1990b).

I divided my study site locations between urban and rural areas and I used the following parameters to make that distinction: for rural areas, lack of infrastructure like schools, hospitals, paved roads, supermarkets, drinking water supply, limited electricity supply, most people being farmers and hunters, low or no-income, most of the houses are made with primary materials like clay or wood; urban areas, education and employment opportunities, access to electricity and water supply, developed housing facilities, proximity to a major urban city, roads and Internet access.

Data analysis:

Household wealth assessment and bushmeat consumption frequencies: To understand the differences between respondents speaking the two major colonial languages French and English and the relationship of their socioeconomic statuses (SES), a tool named basket of owned assets was what we used (Eves & Ruggiero 2000; Brashares et al. 2011).

We used a total of 21 ordinary household items and services (phone credit, refrigerator, freezer, land ownership, floor material, wall material, box TV, electricity, drinking water well, TV-cable, laundry machine, personal satellite dish, internet at home,

toilet facility, air conditioning, dryer, microwave, smart phone, flat screen TV, laptop computer and cars/trucks) in order to ascertain the SES of French and English speakers. For the final analysis, land ownership was excluded due to its complexity in the local context (Brashares et al. 2011).

We gave numerical values, either positive or negative and mainly based on the quality and value of each item, to all those socioeconomic measures, resulting in gaining or losing points per participant. Those values were summed for each individual and created a discrete value variable that we took to represent SES (Takasaki et al. 2000).

Analysis of important relationships: We used the Chi-square test to analyze dependence versus independence variables to understand the differences between variables(Quinn & Keough 2002): 1.) distribution of French and English speakers by location; 2.) bushmeat protein preferences (location, colonial language, ethnicity, gender, age cohorts and education level); 3.) preferences for other protein sources -chicken, fish and beef- (location, colonial language, ethnicity, gender, age cohorts and education level); 4.) preferences for specific bushmeat animals-primate, duikers and porcupine- (location, colonial language, ethnicity, gender, age cohorts and education level); 5.) type of bushmeat last consumed by location; 6.) Location of last bushmeat consumed by location; 7.) use of personal funds to purchase bushmeat by location, education levels; 8.) importance of bushmeat diet by location, education levels, age cohorts; 9.) purchasing site of last bushmeat consumed by location; 10.) knowledge about species protected by law; 11.) opinions about wildlife protection from overhunting (age, education and location).

We sometimes had 2x2 tables with small sample sizes (n<5) and to carry out its analysis, we used Fisher's exact test(Quinn & Keough 2002): 1.) beef protein preferences (coastal vs inland); 2.) fish protein preferences (Fang vs Tikar); 3.) primate protein preferences (geographical location, ethnicity); 4.) preferences of blue duiker (Fang vs Tikar); 5.) chicken protein preferences (geographical location, colonial language), When we had larger tables (>2x2) we sometimes used log odds ratio (Quinn & Keough 2002) for the analysis of differences between variables of interest. For example, willingness of using personal funds to purchase bushmeat versus education levels.

In-depth analysis of relationships between groups: We used the post hoc test, specifically Tukey's honestly significant different (HSD) test to look at differences among specific groups: willingness of using personal funds to purchase bushmeat versus age cohorts (Quinn & Keough 2002). An ANOVA test was first performed to indicate whether there were differences across the groups.

We divided participants into two major geographical locations named coastal and inland regions, where coastal regions refers to respondents from the south, littoral and south-west and inland regions refers to those from the east, center, west, north-west, north and far north.

All the analysis were performed using the statistical program R (R Development Core Team 2015). The level of significance was set at ($p<0.05$).

Results

Characteristics of the respondents:

We administered a total of 213 questionnaires, of which 59 % were in rural areas (5 locations) and 40% in urban areas (16 locations) (Table 4.1 and 4.2a). The

questionnaires were administered between March and October 2015, with some interruptions due to the academic commitments of survey administrators.

Our respondent pool was more rural than the entire country's population distribution, which is 46.2 % rural and 53.8% urban. Our respondent pool was more male (66%) than official records for the country (49.9%). Most of the respondents considered French their principal language (85%) rather than English (15%). The language situation in Cameroon is complex, but many more people speak French (*African Statistical Yearbook, 2015*) (Table 4.2a & b).

Our respondents were 93% Christian (46% Catholic and 47 % Protestant) with a far smaller number of Muslims (7%). Official population statistics for Cameroon list 40% indigenous beliefs, 40% Christian and 20% Muslim (CIA 2016) (Table 4.2b). We expected a smaller-than-all-country percentage of Muslims because the Muslim population is concentrated in the north of the country in sections we didn't survey. Overall our respondents were distributed throughout the age ranges with 90% less than 50 years old. The most common age range was the 20-29 yr. cohort (45%) (Table 4.2b). Our results roughly match those of the entire country, where the representation of individuals less than 50 years old is 91% and the most common age range is also 20-29 years old (34%) (Lapitskiy 2015) (Table 4.2a and Figure **4.3**). Age distribution by gender and by language followed the same pattern (Tables 4.2b and Figure **4.4**)

Our respondents identified with 50 different ethnic groups (Figure **4.3**), which is not unexpected given that the country of Cameroon is home to more than 200 ethnicities (Lewis 2011). Among our respondents the best-represented ethnicities were Fang 16%, Badjoué 14% and Tikar 15%. While the Fang are a larger and fairly clearly defined

group, and the Badjoué are a smaller and well-defined group, the Tikar are a larger but poorly defined group consisting of apparently unrelated tribes. Consequently, their percentage representation in Cameroon is especially difficult to determine (Anchimbe 2007; Rosendal 2008).

Cameroon, like Canada, has both English and French as official languages and the ability to speak either of these colonial languages has political and social significance. We found that the number of French and English respondents varied significantly by location across sample sites in Cameroon ($x^2 = 7.82$, df=1, p-value<0.001): English respondents (60%) were more likely to be found in urban areas than French (40%) respondents (Table 4.2b). Education levels of French and English speakers were significantly different ($x^2 = 18$, df =4, p-value<0.001) with English language speakers more likely to be university-educated (Figure **4.5**). However, French speakers were more likely to be in high socioeconomic status than anglophones (Figure **4.6**).

The Republic of Cameroon has ten major administrative regions, of which two (North-west and South-west) are English speaking and the remaining eight (South, Littoral, West, Center, East, Adamawa, North and Far-north) are French speaking (Ngefac 2010). Our participants originated from nine of the ten regions of Cameroon and only Adamawa was not represented. French was the dominant language across four of the French speaking territories (Center, East, North and South); and English was the leading language in the two English speaking territories (South-west and North-west), together with its neighboring regions West and Littoral (Figure **4.7**).

Given that English was represented almost across all those regions and it turned out to be the dominant language in the neighboring French-speaking regions, it suggest

two things: either there is an active exodus of English speakers migrating into the French-speaking zones or it is likely that more French speakers are becoming more interested in learning English. In fact, the latter point has already been documented (Fonyuy 2010).

Factors influencing food choice in Cameroon

The top four most preferred food protein sources among respondents in Cameroon were 26 % fish, 24% bushmeat, 15% chicken and 12% beef (Figure **4.8**).

Respondents who favored bushmeat: We looked more closely at the characteristics of those respondents who chose bushmeat as a favorite. We found no significant differences between bushmeat protein preferences by gender, nor did we find any significant variations regarding the location of last bushmeat consumed by gender via Chi-square test (Tables 4.4 and 4.5). When respondents were asked whether they thought of bushmeat as an important component for their dietary needs, one third (34%) said 'yes'.

We found no significant patterns in bushmeat protein preferences among age cohorts; likewise, the importance of bushmeat diet for dietary needs was not significant across age ranges via Chi-square test (Table 4.4). However, the relationship regarding the location of last bushmeat consumed versus age ranges was marginally significant (x^2 =9.4, df =1, p-value=0.051): respondents between 50-59 (94%) were more likely to have consumed their last bushmeat meals at home than those 20-29 (32%) (Table 4.5). In addition, the ANOVA testing the willingness of using personal funds to purchase bushmeat or bushmeat related items was highly significant across age cohorts ($p<0.0001$). The Tukey's HSD test revealed that the means of the age ranges 40-49 vs <20 (Tukey-Kramer test, p=0.024) and 40-49 vs 20-29 (Tukey-Kramer test, p=0.017) were significantly different (Figure **4.9**). Therefore, respondents 40-49 had a greater

willingness of using personal funds to purchase bushmeat than <20 and 20-29. The remaining pairs of age

Bushmeat protein preferences among respondents from urban and rural areas was only marginally significant (x^2 =3.6, df =1, p-value=0.057): rural respondents (40%) showed a greater preference for bushmeat than urban (18%) (Figure **4.10**). Bushmeat consumption frequencies among respondents from urban and rural areas also varied significantly (x^2 = 82.2, df=7, p-value<0.0001): as expected, rural respondents were more likely to be in the highest bushmeat consumption categories (daily, several times per week), as opposed to urban respondents (several times per year, about once per year) (Figure **4.11**). Bushmeat consumption frequencies across respondents from Bioko, Equatorial Guinea and Cameroon varied significantly (x^2 = 50.1, df= 7, p-value<0.0001): subjects from Cameroon consumed were more likely to be in the highest bushmeat consumption frequencies (daily, several times per week) than those from Equatorial Guinea (about once per week, about once a month, several times per year) (Figure **4.30**).

The species or species group of bushmeat animals last consumed contrasted significantly across urban and rural respondents (x^2 =33.3, df =5, p-value<0.0001): urban respondents were more likely to consume primate, porcupine and hedgehog bushmeat animals while those from rural areas were more likely to consume duiker bushmeat (Figure **4.12**). The location of the last bushmeat consumed across urban and rural respondents also differed significantly (x^2 =11.4, df =1, p-value<0.0001): rural respondents (72%) were more likely to have their last bushmeat consumed at home than urban respondents (46%) (Table 4.5 and Figure **4.13**). The willingness of using personal funds to purchase bushmeat among urban and rural respondents differed significantly (x^2

=36.04, df =1, p-value<0.0001): rural respondents (91%) were more willing to use personal funds to purchase bushmeat than urban respondents (51%) (Figure **4.14** and Table 4.6). Finally, the purchasing location of last bushmeat consumed among urban and rural respondents differed significantly (x^2=31.5, df=2, p-value<0.0001): urban respondents were more likely to have purchased their last bushmeat consumed from bushmeat markets and those from rural areas were more likely to have purchased from roadside vendors (Figure **4.15**).

We found no significant differences regarding importance of bushmeat diet for dietary needs between urban and rural respondents via Chi-square test (Table 4.6). However, when asked to give reasons why bushmeat was important for dietary needs, urban and rural respondents gave different responses: rural respondents tended to select "good for health" and "cultural links" and while urban respondents selected "fresh protein source" (Figure **4.16**).

To explore a possible relationship between geographical location and bushmeat preference, we divided participants into two major geographical locations named coastal and inland regions, where coastal regions refers to respondents from the south, littoral and south-west and inland regions refers to those from the east, center, west, north-west, north and far north (Figure **4.17**).

Even though there were no significant differences regarding bushmeat protein preferences by geographical location (coastal versus inland regions), primate protein preferences among respondents from coastal (south, littoral and south-west) and inland (east, center, west, north-west, north, and far-north) regions exhibited marginally

significant differences (p-value<0.0417, *Fisher test*): respondents from coastal regions were more likely to favor primates (27 vs 10 percent) (Table 4.6 and Figure **4.18**).

We also delved deeper into the factors that might influence the choice of bushmeat as a favorite food. To begin, we explored the possible relationship between colonial cultural traditions in Cameroon (francophone vs. anglophone) and bushmeat protein preferences. We found no significant differences among French and English speakers regarding bushmeat protein preferences, or importance of bushmeat diet for dietary needs, or bushmeat consumption frequencies via Chi-square test (Table 4.6). Likewise, French and English speakers showed no significant differences regarding bushmeat protein preferences for primate, or duiker, or porcupine via Chi-square test (Table 4.7). French and English speakers, however, contrasted significantly regarding willingness of using personal funds to purchase bushmeat (x^2 =7.28, df=1, p-value<0.001): French respondents (66%) were more willing to use personal funds to purchase bushmeat than English respondents (41%) (Table 4.6 and Figure **4.19**).

Another way to look at the importance of colonial cultural tradition is to compare the same ethnic group, but living in different countries with different colonial traditions. Bi-lingual Cameroon has experienced considerable exchange with English-speaking Nigeria and French-speaking Gabon; Spanish-speaking Equatorial Guinea has had little exchange with any of its neighbors. Bushmeat protein preferences among Fang from Equatorial Guinea and Cameroon exhibited significant dissimilarities (x^2 =29.5, df =1, p-value<0.0001): Fang from Equatorial Guinea (73%) were more likely to favor bushmeat than those from Cameroon (22%) (Figure **20** and Table 4.4). However, the preference for certain species remained the same; we found no significant differences between Fang

from Equatorial Guinea or Cameroon in preferences for specific bushmeat animals/animal groups (primates, duikers, porcupines) via Chi-square test (Table 4.7).

We also compared possible differences with ethnicity within Cameroon but we found no significant differences regarding bushmeat protein preferences across any other pair of ethnicities (Fang vs Badjoué; Fang vs Tikar), nor did we find any significant differences concerning preferences of bushmeat types (primate, blue duiker and porcupine) among these ethnicities (Fang vs Badjoué; Fang vs Tikar) (Tables 4.7 and 4.8). Bushmeat lovers of all ethnicities and colonial traditions in this study prefer to eat primates, duikers and porcupine.

Because education is thought to be an important factor in reducing the consumption of bushmeat (i.e., well-educated people presumably know the conservation consequences and health risks of eating bushmeat), we looked for evidence. Even though there were no significant differences across education levels versus opinions about the importance of bushmeat diet, we found marginally significant differences regarding bushmeat protein preferences across education levels (x^2 =8.194, df=3, p-value=0.0421): 40% respondents with primary education favored bushmeat more than the other education levels (Tables 4.7 & 4.8 and Figure **4.21**).

Similarly, the willingness of using personal funds to purchase bushmeat across education levels exhibited a very strong relationship (Ln (odds ratio):1.89; 95% CI: -1.177, -2.604). Highly educated individuals were less likely to use their personal funds to purchase bushmeat than any other education level (Figure **4.22**).

Some religions specifically forbid the consumption of certain types of protein, but none of the religions in our survey (Christian and Muslim) have an overall ban on eating

wild animals. Therefore it was not surprising that respondents' religions made no significant contribution in predicting whether someone liked bushmeat protein or not (Table 4.7).

Respondents who favored other sources of protein: We looked more closely at the characteristics of those respondents who chose something other than bushmeat as a favorite. Although bushmeat was favored by 24% of our respondents, fish (26%) was actually slightly more popular, and chicken (15%) and beef (12%) were also frequent selections (Figure **4.8**).

When we looked to see the influence of location (coastal vs inland; urban vs rural), we found no significant associations regarding any type of non-bushmeat protein preferences (fish, chicken, beef) among respondents from coastal (south, littoral and south-west) and inland (east, center, west, north-west, north, far-north) regions of Cameroon (Tables 4.8 and 4.9). We found no significant differences across urban and rural respondents regarding preferences for domestic source of protein (chicken, fish and beef) (Table 4.8).

We also looked for cultural influences on non-bushmeat food preferences. French and English speakers showed no significant differences in their preference for fish or chicken (Chi-square test) but they did have a marginally significant difference in their preference for beef (p-value = 0.05, *Fisher's exact test*): English respondents (23%) were more likely to favor beef protein than French respondents (10%) (Table 4.9).

Even though Fang respondents from both Cameroon and Equatorial Guinea showed similarities in their preferences for chicken, they differed significantly in their

preferences for fish (x^2=13.662, df =1, p-value<0.0001): Fang from Cameroon were more likely to prefer fish than Fang from Equatorial Guinea (38 vs 11 percent) (Table 4.9 and Figure **4.24**).

Within Cameroon, only the difference between Fang and Tikar preference for fish was statistically significant (p-value<0.001, *Fisher test*): 37% Fang were more likely to prefer fish protein than 9% Tikar (Figure **4.25**). However, we found no significant relationship regarding any other type of domestic protein source (fish, chicken, and beef) among the pairs of ethnicities (Fang vs Badjoué; Fang vs Tikar) (Table 4.9).

Public opinion regarding biodiversity conservation issues:

Because "awareness campaigns," which are intended to educate the public about conservation issues, are always an important component of efforts to protect endangered wildlife, we wanted to see if Cameroonians knew about conservation issues. We also wanted to measure their opinions on the messages typically conveyed in conservation awareness campaigns, which might be summarized "Endangered wildlife should be protected in well-guarded protected areas."

When asked if wildlife should be protected from overhunting, an overwhelming majority (89%) agreed. We found no significant contrast regarding opinions about whether wildlife should be protected from overhunting among respondents from urban and rural areas, or across education levels, or age cohorts via Chi-square test (Table 4.10). When we asked why wildlife should be protected we saw some differences in response between urban and rural locations. Urban dwellers chose "biodiversity preservation" and "for tourists to see" while rural people chose "heritage preservation" and "hunt trap for food" (Figure **4.26**). When asked for their opinion about the presence of well-paid and government-supported forest guards in the protected areas, again an

overwhelming majority (65%) approved (strongly agree or agree), regardless of location (Figure **4.27**).

We also measured the awareness of government legislation protecting endangered wildlife. The government of Cameroon has enacted laws and issued presidential decrees to protect wildlife. In January 1994, the Law No.94/01 (Republic of Cameroon) was enacted, establishing forestry, wildlife and fisheries regulations throughout the entire country of Cameroon. Twelve years after its enactment, important mechanisms were put in place for its effective implementation. For example, in December 2006, the Presidential Order No.0648 (Republic of Cameroon), categorized animals into three classes, based on legal level of protection, with class A animals having the greatest protection. In fact, the majority of species (primates, elephants, crocodiles, pangolins, leopard, lions, sea turtles, etc.) reported by respondents are listed in the aforementioned presidential order. Knowledge about whether certain species of wildlife are protected by law among urban and rural respondents contrasted considerably ($x^2 = 18.2$, df=4, p-value<0.001): urban respondents were more likely to report elephants, lions and ungulates and those from rural areas primates and other species like crocodiles, pangolin, sea turtles and snakes (Figure **4.28**). The top three recommendations provided by the public to implement conservation policies in Cameroon were well-paid forest guards, law enforcement and public awareness campaigns (Figure **4.29**).

Discussion:

Respondent Pool: In initiating this survey of public attitudes towards bushmeat and biodiversity conservation in Cameroon we intended to compare two respondent pools, this survey in Cameroon with a previous survey on Bioko Island. The degree to which

each respondent pool represents the citizens of the country, or at least a certain part of the country, was important.

Because Cameroon has natural habitats that range from rainforest and mountains nearer to the coast (like Bioko) to inland savanna (unlike Bioko) we wanted to emphasize the parts of the country similar to Bioko. Therefore we administered our questionnaire in forested parts of the country. We chose to administer more of our questionnaires in rural locations (66%), which was considerably higher percentage than the country's 46% rural citizens, because our other questionnaire, administered on Bioko Island, was biased toward rural citizens. And because Cameroon citizens are more mobile than citizens on Bioko, we expected our sample to be more ethnically diverse. However, some of our differences can't be explained by these factors: we clearly had too many men in our sample, and our most common ethnic groups (Fang, Badjoué and Tikar) were probably over-represented. This latter discrepancy was balanced by the fact that having so many Cameroonian Fang made comparisons with Bioko Island Fang possible.

Factors influencing food choice: Cameroonian citizens selected bushmeat as a favorite source of protein far less frequently than the Equatoguineans living on Bioko Island (25.8% vs 70.7%), and they selected other sources of protein more frequently: fish (28.1% vs 12.4%); chicken (14.5% vs 10.9%); and, beef (11.7% vs 3.8%). Fish, not bushmeat, was the favorite dinner choice among our Cameroonian participants.

Why do people living on Bioko have a much greater preference for bushmeat than those living in Cameroon? Ethnicity can be ruled out because the one group living in both places, the Fang people, are no different from their fellow citizens in their

preference for bushmeat. Cameroonian Fang select bushmeat at the same rate as other Cameroonians; Bioko Island Fang select bushmeat at the same rate as other citizens on Bioko Island. Even the details of Fang bushmeat animal preference (primates, duikers, porcupine) remain the same between the two countries. Colonial culture alone is also unlikely to be the cause of the difference because English-speaking Cameroonians and French-speaking Cameroonians also select bushmeat at the same rate, and with the same animal preferences.

Part of the answer to the reduced preference for bushmeat in Cameroon compared to Bioko Island might lie with the recent history of each country. Equatorial Guinea suffered massive set-backs in national development and infrastructure, especially transportation, after independence. Cameroon was more fortunate. Fish, and other sources of protein could be transported to major urban centers on a reliable system of roads. Even the recent improvements made by Equatorial Guinea with new-found petroleum wealth can't erase the fact that just 35 years ago (the end of the Macias years) many of the people in Equatorial Guinea had to rely on bushmeat because there were few other sources of protein. Another contributing factor was the relative lack of fish to be transported in Equatorial Guinea: during the Cold War the Soviets used Bioko Island as a base for factory ships supplying fish to their homeland (Liniger-Goumaz 1988); later, even after fish stocks began to recover, President Obiang discouraged smaller artisanal fishing boats.

When we looked more closely at our respondents who preferred bushmeat in Cameroon we found no significant differences in preferences of bushmeat across urban and rural location; however, those from rural locations were more likely to eat bushmeat

more frequently, to have had their last bushmeat meal at home, and to be more willing to use their own money to buy bushmeat than urban responders. The species consumed at the last bushmeat meal also differed with rural respondents naming duikers while urban responders named primates, porcupine and hedgehog. We did not find a similar well-defined profile for rural people when we surveyed Bioko Island.

We were disappointed that neither education nor age cohort produced a distinct pattern among bushmeat consumers. As conservationists, we hoped that more education would lead to less preference for bushmeat, and there were some indications: Among those who chose bushmeat as their favorite, the percentage of university-educated respondents was lower (but not significantly so) than other educational categories; and, the percentage of university-educated respondents who would use their own money to purchase bushmeat was significantly lower than other educational categories. However, in both cases the picture is clouded by the fact that "no education" scored second lowest. The Bioko Island results were similarly suggestive but weak.

There was no significant differences in the preferences of domestic sources of protein (fish, chicken, and beef) across urban and rural locations. Fang people living in Cameroon showed a strong preference for fish when compared to Fang people living on Bioko Island and, but to a lesser extent, Tikar people living in Cameroon. The fact that even the Fang people, who are traditionally forest-dwellers with a reputation as hunters, can switch to fish indicates that the preference for bushmeat can be changed, especially when fresh alternatives are available.

Public opinion regarding biodiversity conservation issues:

Our Cameroonian respondents were uniformly supportive of the concept of protecting wildlife from overhunting (90%), a rate that was considerably higher than the support expressed for the same concept by respondents on Bioko Island (72.2%). Although "heritage preservation" was the most common reason for supporting wildlife protection, city dwellers were more likely chose "for tourists to see" and "biodiversity preservation" than rural respondents. Cameroonian respondents rarely cited the reasons "income" and "food source," but these were common responses on Bioko Island, especially among rural people, another indication that using wildlife as a back-up food source is still a recent memory in Equatorial Guinea.

The people of Cameroon were generally aware of national laws regarding wildlife protection and many were able to name protected species, although urban people were more likely to name charismatic megavertebrates (elephants, lions, ungulates) and rural people were more likely to be creative (primates, crocodiles, pangolins, snakes). When asked how to protect this wildlife, the respondents went with supply side controls, well paid forest guards and law enforcement, although awareness campaigns, more of a demand side strategy, ranked third.

Overall, the responses to our questionnaire indicate that Cameroon has slightly moved away from bushmeat as a traditional source of protein, possibly because other fresh proteins sources, especially fish, have become widely available. Bioko Island's continued preference for bushmeat is unexplained, especially because fish are readily available. However, the experience of the Fang people in Cameroon, now mirroring the general population's lower level of bushmeat preference, gives hope that Bioko Island can also change its preferences.

TABLES FOR CHAPTER 4

Table 4.1: Geographical locations and number of completed questionnaires at each survey location in Cameroon

Locations	Urban & Rural	Regions	N# of Questionnaires
Biyem-Asi	Urban	Center	4
Melen	Urban	Center	3
Mvan	Urban	Center	11
Mvog-Ada	Urban	Center	5
Ngoa-Ekelle	Urban	Center	13
Nkoabang	Urban	Center	10
Nkol-Bison	Urban	Center	10
Oyom-Abang	Urban	Center	3
Tekace	Urban	Center	3
Tongolo	Urban	Center	7
Carrefour Foe_Soa	Urban	Center	1
Fin Goudron Soa	Urban	Center	5
Mvog Atangana Mballa	Urban	Center	2
Mvog-Mbi	Urban	Center	1
Soa	Urban	Center	5
Titi Ezoa	Urban	Center	4
Total urban	16		87
Deng-deng	Rural	East	41
Ngambe-tikar	Rural	Center	46
Okoa	Rural	South	3
Okola	Rural	Center	1
Somalomo	Rural	East	35
Total rural	5		126
Grand Total	**21**		**213**

Table 4.2 a): Characteristics (location, gender, age cohorts) of survey participants compared to actual country data in Cameroon.

Characteristics	Cameroon survey (N=213)		Actual country data (N=22,819,000)	
	%	N	%	N
Location				
Urban	40%	(n=87)	53.8%	(n=12,276,622)*
Rural	59%	(n=126)	46.2%	(n=10,542,378)
Gender				
Female	34%	(n=73)	50.1%	(n=11,410,000)*
Male	66%	(n=140)	49.9%	(n=11,408,000)
Age cohorts		*(N=202)*		*(N=10,982,000)***
<20 yrs.	8%	(n=17)	22%	(n=2,407,000)
20-29 yrs.	45%	(n=91)	34%	(n=3,725,000)
30-39 yrs.	24%	(n=49)	21%	(n=2,354,000)
40-49 yrs.	12%	(n=26)	14%	(n=1,554,000)
50-59 yrs.	9%	(n=19)	8%	(n=942,000)

***Data about the entire country's distribution of locations and gender distribution were extracted from the African Statistical Yearbook, 2015.*

***Data about the country's actual age distribution was extracted from the Open Data for Africa website ;< 20 includes age cohorts between 15-19 yrs. old: http://cameroon.opendataforafrica.org/rfdefze/census-data*

Table 4.2 b): Characteristics (location, gender, age cohorts, religion, language, education, age cohorts versus main language, main language versus location) of survey participants Cameroon

Characteristics	Cameroon survey (N=213)	
	(%)	N
Survey location	*(N=213)*	
Urban	33%	(n=69)
Rural	67%	(n=144)
Gender	*(N=213)*	
Male	66%	(n=140)
Female	34%	(n=73)
Age cohorts	*(N=210)*	
<20	8%	(n=17)
20-29	43%	(n=91)
30-39	23%	(n=49)
40-49	12%	(n=26)
50-59	9%	(n=19)
60-69	1.4%	(n=3)
>70	2.3%	(n=5)
Religion	*(N=179)*	
Catholic	46%	(n=83)
Protestant	47%	(n=84)
Muslim	6.7%	(n=12)
French & English speakers	*(N=237)*	
French	86%	(n=203)
English	14%	(n=34)
Education	*(N=210)*	
None	4.2%	(n=9)
Primary	24.7%	(n=52)
Secondary	44.7%	(n=94)
Vocational	4.2%	(n=9)
University	21.9%	(n=46)
Age cohorts by Language	*French (n=194)*	*English(n=33)*
<20 yrs.	8% (n=17)	6% (n=2)
20-29 yrs.	43% (n=84)	60% (n=20)
30-39 yrs.	25% (n=49)	21% (n=7)
40-49 yrs.	12% (n=25)	9% (n=3)
50-59 yrs.	9% (n=19)	3% (n=1)
Language by location	*Urban*	*Rural*
French	40% (n=82)	67% (n=122)
English	60% (n=23)	33% (n= 11)

Table 4.3: Comparison of age ranges by sexes in our survey to the entire country's records in Cameroon

Age cohorts by gender	Survey data (N=202)		Actual country data (N=10,979,000)	
	Male (n=131)	*Female (n=71)*	*Male(n=5,311,000)*	*Female (n=5,668,000)*
<20 yrs.	6% (n=9)	11% (n=8)	22% (n=1,176,000)	21%(n=1,230,000)*
20-29 yrs.	48% (n=63)	39%(n=28)	32% (n=1,737,000)	32%(n=1,987,000)
30-39 yrs.	24% (n=32)	23%(n=17)	21% (n=1,146,000)	21%(n=1,208,000)
40-49 yrs.	11% (n=15)	15%(n=11)	14%(n=771,000)	13%(n=782,000)
50-59 yrs.	9% (n=12)	9%(n=7)	9%(n=481,000)	8%(n=461,000)

**Age cohorts by gender about the entire country was extracted from the Open Data for Africa Website; <20 includes age cohorts between 15-19 yrs. old: http://cameroon.opendataforafrica.org/rfdefze/census-data*

Table 4.4: a) Bushmeat protein preferences across ethnicity (Fang from Cameroon vs Fang from Equatorial Guinea), gender (male vs female), age cohorts; b) Age cohorts versus both willingness of using personal funds to purchase bushmeat and opinions regarding the importance of bushmeat diet in Cameroon.

Relationship	Cameroon survey (N=213)		Statistical comparison
Bushmeat protein preferences (Fang Cameroon vs Fang EG)	Yes	No	(x^2=29.5, df=1, p<0.0001)
Fang Cameroon	22% (n=8)	77%(n=28)	
Fang Equatorial Guinea	73%(n=99)	26%(n=36)	
Bushmeat protein preferences by gender			(x^2=0.04, df=1, p=0.8302)
Male	25%(n=35)	75%(n=105)	
Female	27%(n=20)	72%(n=53)	
Bushmeat protein preferences by age cohorts			(x^2=8.329, df=4, p=0.139)
<20 yrs.	11%(n=2)	88%(n=15)	
20-29 yrs.	20%(n=19)	79%(n=72)	
30-39 yrs.	36%(n=18)	63%(n=31)	
40-49 yrs.	26%(n=7)	73%(n=19)	
50-59 yrs.	26%(n=5)	73%(n=14)	
Use of personal funds to purchase bushmeat by age cohorts			(x^2=20.09,df=4,p<0.0001)
<20 yrs.	47%(n=8)	52%(n=9)	
20-29 yrs.	53%(n=49)	46%(n=42)	
30-39 yrs.	77%(n=38)	22%(n=11)	
40-49 yrs.	92%(n=24)	7%(n=2)	
50-59 yrs.	73%(n=14)	26%(n=5)	
Importance of bushmeat diet by age cohorts			(x^2=1.509, df=4, p=0.825)
<20 yrs.	42%(n=6)	57%(n=8)	
20-29 yrs.	32%(n=25)	67%(n=52)	
30-39 yrs.	30%(n=14)	69%(n=32)	
40-49 yrs.	30%(n=7)	69%(n=16)	
50-59 yrs.	42%(n=8)	57%(n=11)	

Table 4.5: Location of last bushmeat consumed across gender, age cohorts, and location (urban vs rural) in Cameroon.

Measure	Home	Away from home	Statistical comparison
Location of bushmeat consumption by gender			(x^2=0.008,df=1,p=0.92)
Male	75%(n=94)	24%(n=31)	
Female	77%(n=47)	22% (n=14)	
Location of bushmeat consumption by age cohorts			(x^2=9.41, df=4, p=0.05)
<20 yrs.	71%(n=10)	28%(n=4)	
20-29 yrs.	67%(n=52)	32%(n=25)	
30-39 yrs.	72%(n=31)	27%(n=12)	
40-49 yrs.	91%(n=22)	8%(n=2)	
50-59 yrs.	94%(n=16)	5%(n=1)	
Location of bushmeat consumption by location			(x^2=11.4, df=1, p<0.0001)
Urban	46%(n=32)	53%(n=37)	
Rural	72%(n=78)	27%(n=29)	

Table 4.6: a) Bushmeat protein preferences versus location (urban vs rural), geographical location (coastal vs inland), colonial language (French vs English); b) willingness of using personal funds to purchase bushmeat versus location (urban vs rural), colonial language (French vs English); c) opinions regarding the importance of bushmeat diet across location (urban vs rural), colonial language (French vs English); d) primate protein preferences versus geographical location (coastal vs inland) in Cameroon.

Measure	Cameroon survey (N=213)		Statistical comparison
	Yes	No	
Bushmeat protein preferences by location			(x^2=3.6, df=1, p<0.057)
Urban	18%(n=16)	82%(n=59)	
Rural	40%(n=39)	60%(n=99)	
Use of personal funds to purchase bushmeat by location			(x^2=36.04, df=1, p<0.0001)
Urban	51%(n=37)	49%(n=35)	
Rural	91%(n=104)	9%(n=10)	
Importance of bushmeat diet by location			(x^2=0.852, df=1, p=0.356)
Urban	26%(n=23)	74%(n=64)	
Rural	33%(n=42)	67%(n=84)	
Bushmeat protein preferences by geographical location			(x^2=1.3005e-29, df=1, p=1)
Coastal	27%(n=6)	72%(n=16)	
Inland	25%(n=49)	74%(n=142)	
Primate protein preferences by geographical location			(p<0.0417, *Fisher test*)
Coastal	27%(n=6)	72%(n=16)	
Inland	10%(n=21)	89%(n=170)	
Bushmeat protein preferences by language			(x^2= 0.0082, df=1, p=0.927)
French	25%(n=53)	74%(n=151)	
English	23%(n=8)	76%(n=26)	
Importance of bushmeat diet by language			(x^2= 0.285, df=1, p=0.5934)
French	34%(n=63)	65%(n=118)	
English	28%(n=9)	71%(n=23)	
Use of personal funds to purchase bushmeat by language			(x^2= 7.2813, df=1, p<0.001)
French	41%(n=14)	58%(n=20)	
English	66%(n=136)	33%(n=67)	

Table 4.7: Preferences for particular bushmeat species and species groups (primate, duiker or porcupine) between groups with different colonial traditions (English, French or Spanish) or different ethnicities (Fang, Badjoué, Tikar) in Cameroon.

Measure	Cameroon survey (N=213)		Statistical comparison
	Yes	No	
Primate protein preferences by language			(x^2= 2.1917, df=1, p=0.138)
French	12%(n=25)	87%(n=178)	
English	23%(n=8)	76%(n=26)	
Duiker protein preferences by language			(x^2= 0.429, df=1, p=0.5122)
French	11%(n=23)	88%(n=180)	
English	5%(n=2)	94%(n=32)	
Porcupine protein preferences by language			(x^2=6.9387e-31, df=1, p=1)
French	23%(n=47)	76%(n=156)	
English	23%(n=8)	76%(n=26)	
Primate preferences by ethnicity			(x^2=0.008, df=1, p=0.927)
Fang Cameroon	19%(n=7)	80%(n=29)	
Fang Equatorial Guinea	17%(n=23)	82%(n=112)	
Porcupine preferences by ethnicity			(x^2=0.179, df=1, p=0.6717)
Fang Cameroon	25%(n=9)	75%(n=27)	
Fang Equatorial Guinea	20%(n=27)	80%(n=108)	
Bushmeat protein preferences by ethnicity			(x^2=0.206, df=1, p=0.6492)
Fang	24%(n=9)	75%(n=28)	
Badjoué	32%(n=10)	67%(n=21)	
Primate bushmeat protein preferences by ethnicity			(p-value=0.06, *Fisher test*)
Fang	18%(n=7)	81%(n=30)	
Badjoué	3.2%(n=1)	96%(n=30)	
Blue duiker bushmeat protein preferences by ethnicity			(p-value=0.085, *Fisher test*)
Fang	2.7%(n=1)	97%(n=36)	
Badjoué	16%(n=5)	83%(n=26)	
Porcupine bushmeat protein preferences by ethnicity			(x^2=1.699 , df=1, p=0.1923)
Fang	27%(n=10)	72%(n=27)	
Badjoué	45%(n=14)	54%(n=17)	
Bushmeat protein preferences by ethnicity			(x^2=0.322, df=1, p=0.5701)
Fang	24%(n=9)	75%(n=28)	
Tikar	33%(n=11)	66%(n=22)	

Table 4.8: a) Preferences for particular bushmeat species (primate, blue duiker and porcupine) between ethnicities (Fang, Tikar, Badjoué); b) importance of bushmeat diet versus education; c) bushmeat protein preferences versus religion; d) preferences of domestic protein sources (chicken, fish and beef) between different types of locations (urban, rural, coastal, and inland)

Measure	Cameroon survey (**N=213**)		Statistical comparison
	Yes	No	
Primate bushmeat protein preferences by ethnicity			(x^2=0.009, df=1, p=0.9205)
Fang	18%(n=7)	81%(n=30)	
Tikar	15%(n=5)	84%(n=28)	
Blue duiker bushmeat protein preferences by ethnicity			(p=0.0463, *Fisher test*)
Fang	2.7%(n=1)	97%(n=36)	
Tikar	18%(n=6)	81%(n=27)	
Porcupine bushmeat protein preferences by ethnicity			(x^2=7.0351e-31, df=1, p=1)
Fang	27%(n=10)	72%(n=27)	
Tikar	24%(n=8)	75%(n=25)	
Importance of bushmeat diet versus education			(x^2=2.498, df=4, p=0.6448)
None	42%(n=3)	57%(n=4)	
Primary	32%(n=16)	68%(n=34)	
Secondary	38%(n=33)	61%(n=53)	
Vocational	42%(n=3)	57%(n=4)	
University	25%(n=10)	74%(n=29)	
Bushmeat protein preferences versus religion			(x^2=2.8101, df=2, p=0.245)
Catholic	31%(n=26)	68%(n=57)	
Muslim	13%(n=3)	86%(n=19)	
Other	26%(n=22)	73%(n=62)	
Fish protein preferences by location			(x^2=2.394, df=1, p=0.121)
Urban	34%(n=30)	66%(n=57)	
Rural	23.8%(n=30)	76.2%(n=96)	
Chicken protein preferences by location			(x^2=1.6851e-30, df=1, p=1)
Urban	15%(n=13)	85%(n=74)	
Rural	14%(n=18)	86%(n=108)	
Beef protein preferences by location			(x^2=0.98, df=1, p=0.321)
Urban	15%(n=13)	85%(n=74)	
Rural	9.5%(n=12)	90.5%(n=114)	
Fish protein preferences by geographical location			(x^2=0.02, df=1, p=0.87)
Coastal	31%(n=7)	68%(n=15)	
Inland	27%(n=53)	72%(n=138)	
Chicken protein preferences by geographical location			(p-value=1, *Fisher test*)
Coastal	13%(n=3)	86%(n=19)	
Inland	14%(n=28)	85%(n=163)	

Table 4. 9: Preferences for domestic protein sources (beef, fish, chicken) between type of locations (urban, rural, coastal and inland), colonial languages (French, English), and ethnicities (Fang from Equatorial Guinea, Fang from Cameroon, Tikar, Badjoué) in Cameroon.

Measure	Cameroon survey (N=213)		Statistical comparison
	Yes	No	
Beef protein preferences by location			(p-value=0.728, *Fisher test*)
Coastal	13% (n=3)	86% (n=19)	
Inland	11% (n=22)	85% (n=169)	
Fish protein preferences by language			(x^2=2.202 , df=1, p=0.1378)
French	28% (n=58)	71%(n=145)	
English	14%(n=5)	85%(n=29)	
Chicken protein preferences by language			(p-value=0.795, *Fisher test*)
French	15%(n=31)	84%(n=172)	
English	11%(n=4)	88%(n=30)	
Beef protein preferences by language			(x^2=3.17 , df=1, p=0.07)
French	10%(n=22)	89%(n=181)	
English	23%(n=8)	76%(n=26)	
Fish protein preferences by ethnicity			(x^2=13.6, df=1, p<0.0001)
Fang Cameroon	38%(n=14)	61%(n=22)	
Fang Equatorial Guinea	11%(n=15)	88%(n=120)	
Chicken protein preferences by ethnicity			(x^2=0.566 , df=1, p=0.451)
Fang Cameroon	16%(n=6)	83%(n=30)	
Fang Equatorial Guinea	10%(n=14)	89%(n=121)	
Fish protein preferences by ethnicity			(x^2=0.05 , df=1, p=0.822)
Fang	37%(n=14)	62%(n=23)	
Badjoué	32%(n=10)	67%(n=21)	
Chicken protein preferences by ethnicity			(x^2=0.0003, df=1, p=0.985)
Fang	16%(n=6)	83%(n=31)	
Badjoué	19%(n=6)	80%(n=25)	
Fish protein preferences by ethnicity			(p-value<0.001, *Fisher test*)
Fang	37%(n=14)	62%(n=23)	
Tikar	9%(n=3)	90%(n=30)	
Chicken protein preferences by ethnicity			(x^2=0.05 , df=1, p=0.8191)
Fang	16%(n=6)	83%(n=31)	
Tikar	21%(n=7)	78%(n=26)	
Beef protein preferences by ethnicity			(p-value=1, *Fisher test*)
Fang	5.4%(n=2)	94%(n=35)	
Tikar	6%(n=2)	93%(n=31)	

Table 4. 10: Opinions regarding wildlife protection from overhunting between age cohorts, location (urban, rural) and education levels in Cameroon.

Measures	Cameroon survey (N=213)		Statistical comparison
	Yes	No	
Wildlife protection from overhunting by age cohorts			(x^2=2.84, df=4, p=0.584)
<20 yrs.	93%(n=150	6%(n=1)	
20-29 yrs.	89%(n=80)	10%(n=9)	
30-39 yrs.	89%(n=44)	10%(n=5)	
40-49 yrs.	86%(n=19)	13%(n=3)	
50-59 yrs.	77%(n=14)	22%(n=4)	
Wildlife protection from overhunting by locations			(x^2=0.375, df=1, p=0.540)
Urban	87%(n=76)	13%(n=11)	
Rural	83%(n=105)	17%(n=21)	
Wildlife protection from overhunting versus education levels			(x^2=6.574 , df=4, p=0.1601)
None	75%(n=6)	25%(n=2)	
Primary	81%(n=39)	18%(n=9)	
Secondary	93%(n=85)	6.5%(n=6)	
Vocational	87%(n=7)	12%(n=1)	
University	91%(n=41)	8%(n=4)	

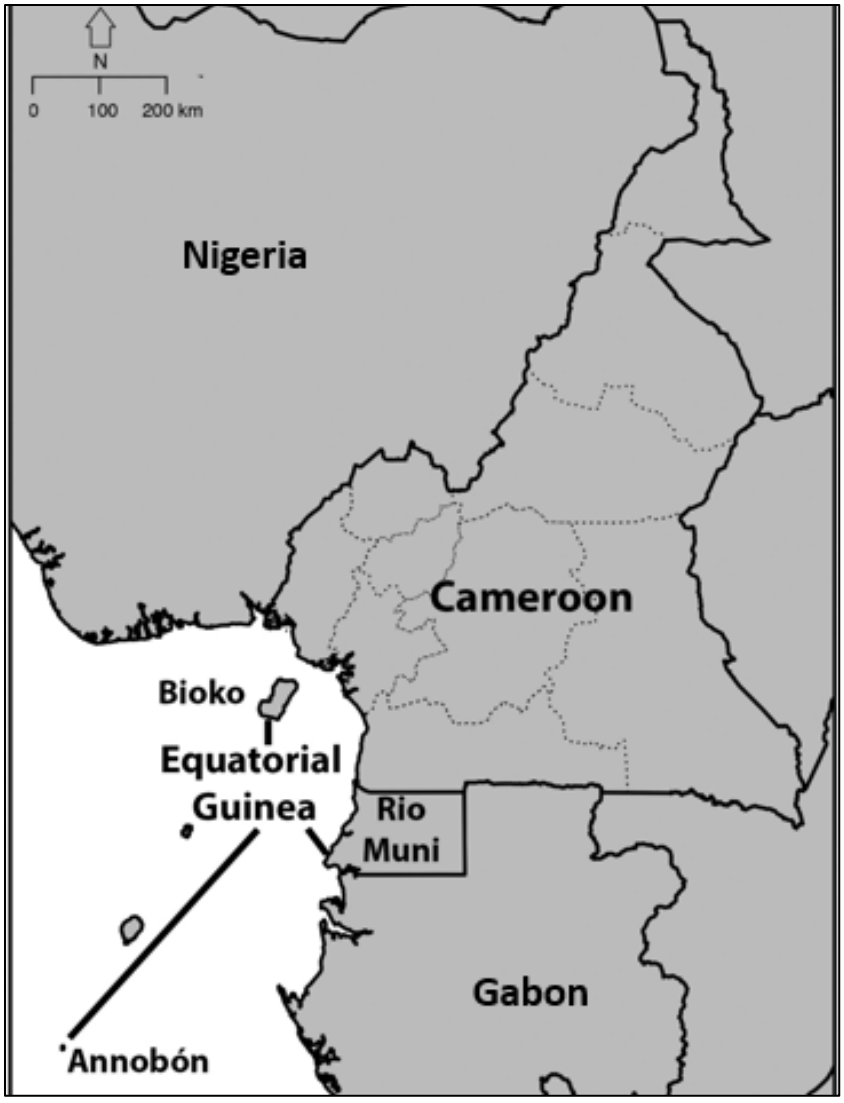


Figure 4.1. Geographic location of Cameroon in west-central Africa showing its relationship to the neighboring countries Equatorial Guinea (Spanish-speaking), Nigeria (English-speaking) and Gabon (French-speaking).

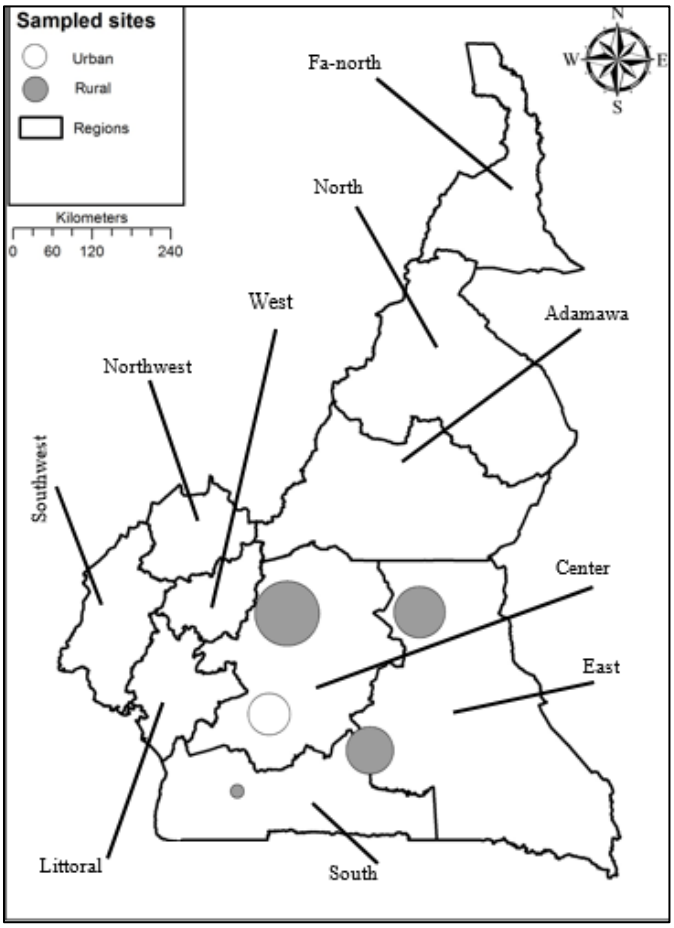


Figure 4.2: Research sites in Cameroon: urban (Yaoundé, Center, 10 sites) and rural (East, 2 sites; South, 1 site; Center, 8 sites).

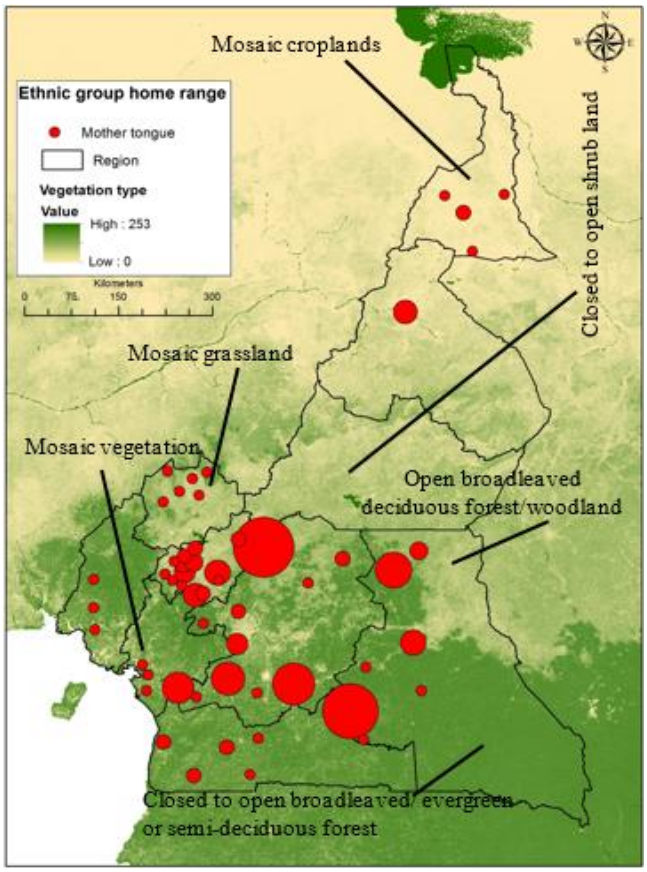
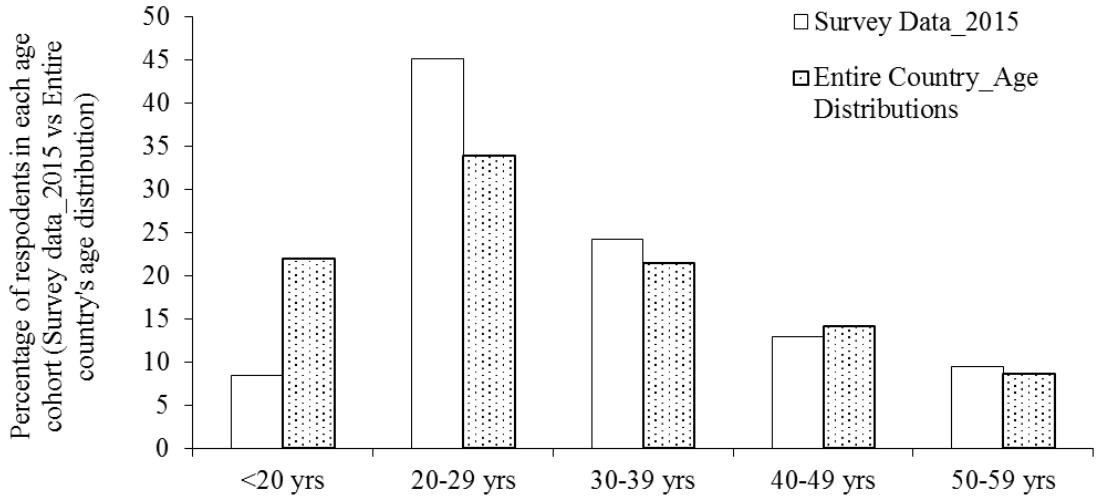


Figure 4.3: Distribution of indigenous languages spoken by respondents; and vegetation types in Cameroon.



**Data about the entire country's age range distribution was extracted from the Open Data for Africa website: http://cameroon.opendataforafrica.org/rfdefze/census-data.*
Figure 4.4: Distribution of age cohorts between survey data and entire country's age distribution in Cameroon.

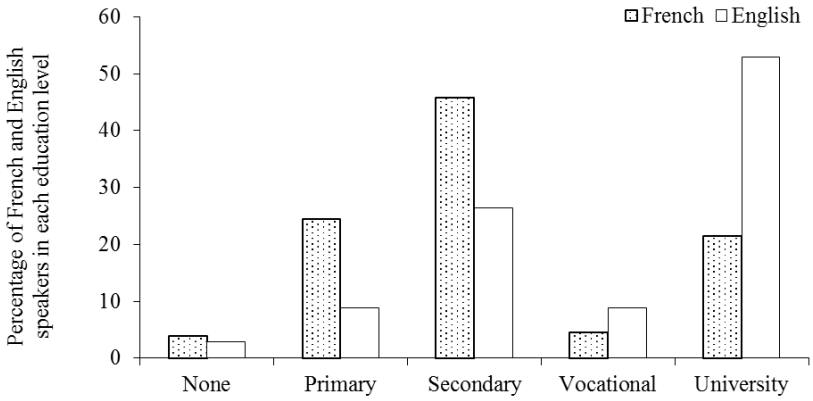


Figure 4.5: Education levels across English and French speakers in Cameroon.

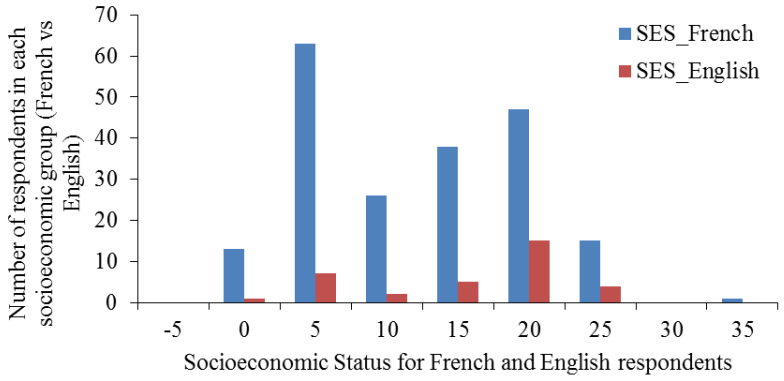


Figure 4.6: Socioeconomic statuses for French and English respondents in Cameroon.

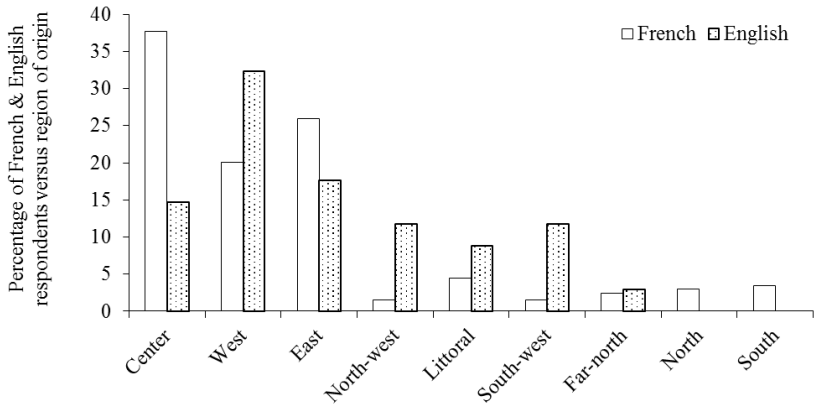


Figure 4.7: Main language spoken vs regions of origin among participants in Cameroon.

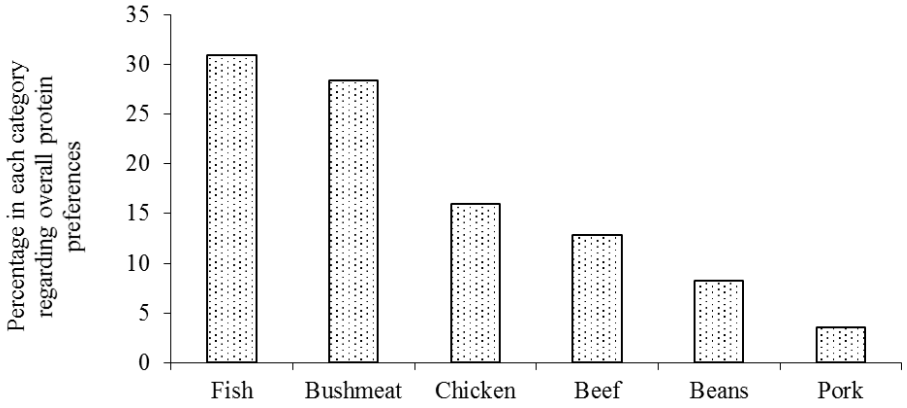


Figure 4.8: Overall protein preferences among respondents in Cameroon.

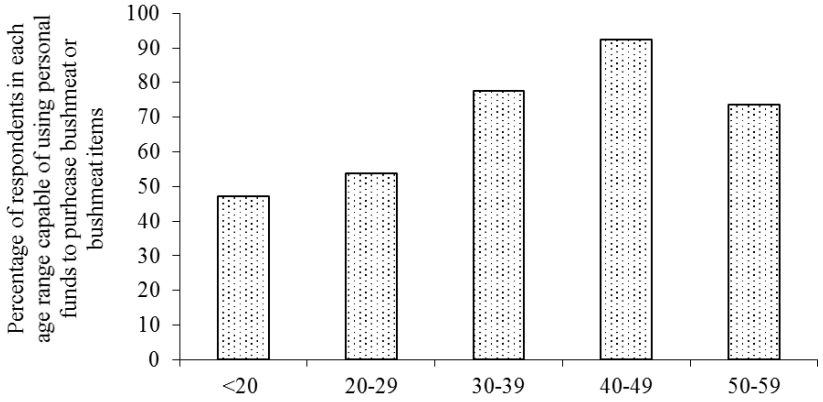


Figure 4.9: Use of personal funds to purchase bushmeat across age cohorts in Cameroon.

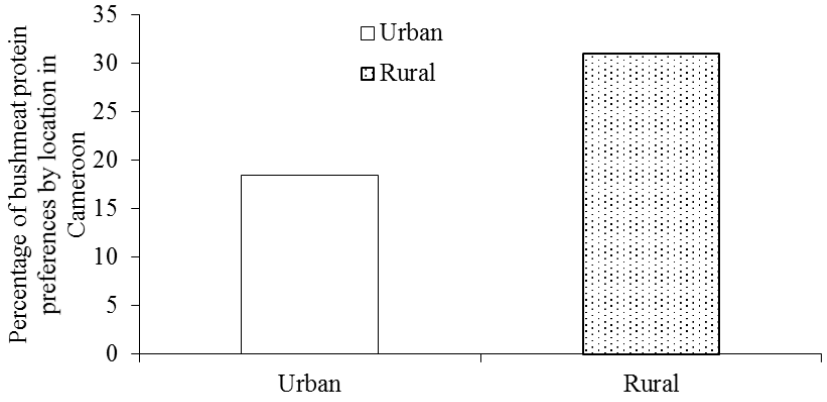


Figure 4.10: Bushmeat protein preferences between respondents from urban and rural areas in Cameroon.

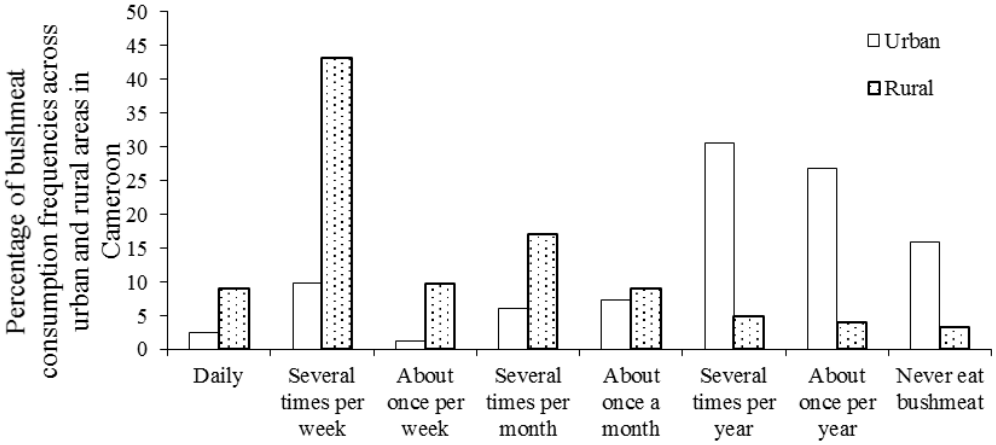


Figure 4.11: Bushmeat consumption frequencies between urban and rural areas in Cameroon.

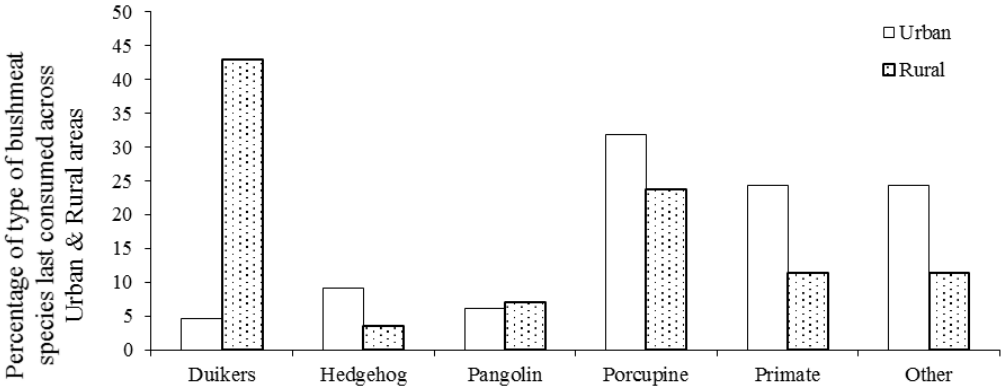


Figure 4.12: Bushmeat animals last consumed between urban and rural respondents in Cameroon.

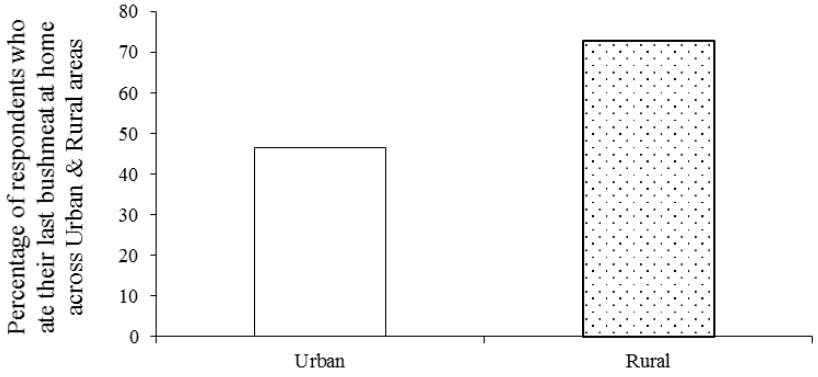


Figure 4.13: Location of last bushmeat consumed between urban and rural respondents in Cameroon.

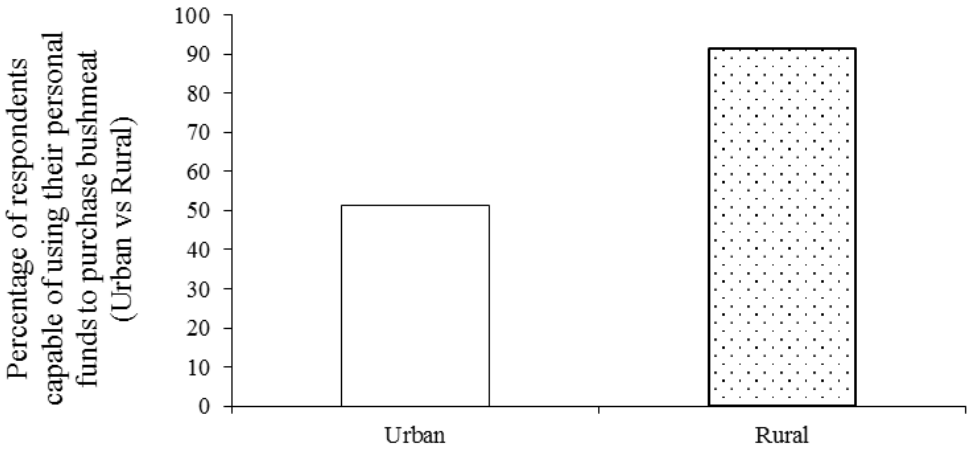


Figure 4.14: Use of personal funds to purchase bushmeat versus location in Cameroon.

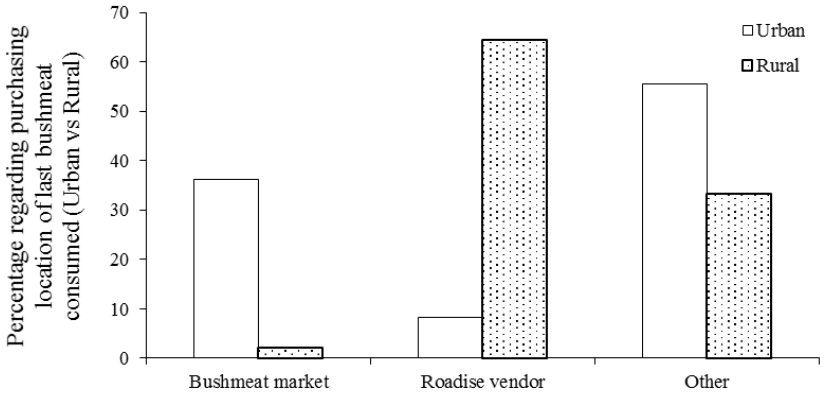


Figure 4.15: Purchasing location of last bushmeat consumed across urban and rural areas in Cameroon.

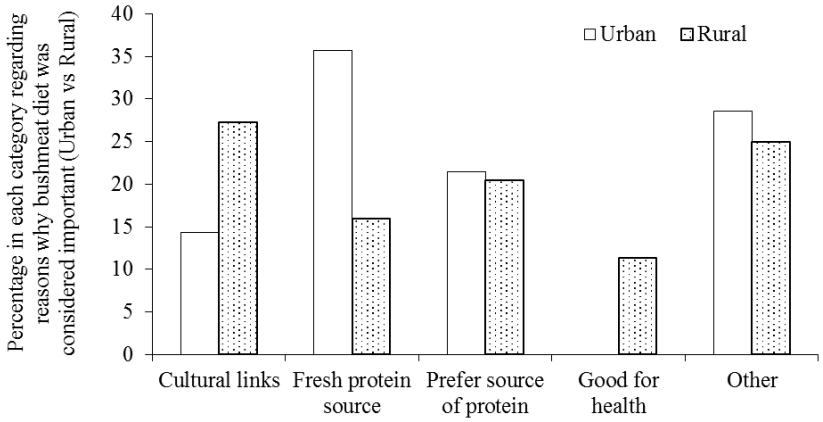


Figure 4.16: Reasons why bushmeat is important for dietary needs between urban and rural respondents in Cameroon.

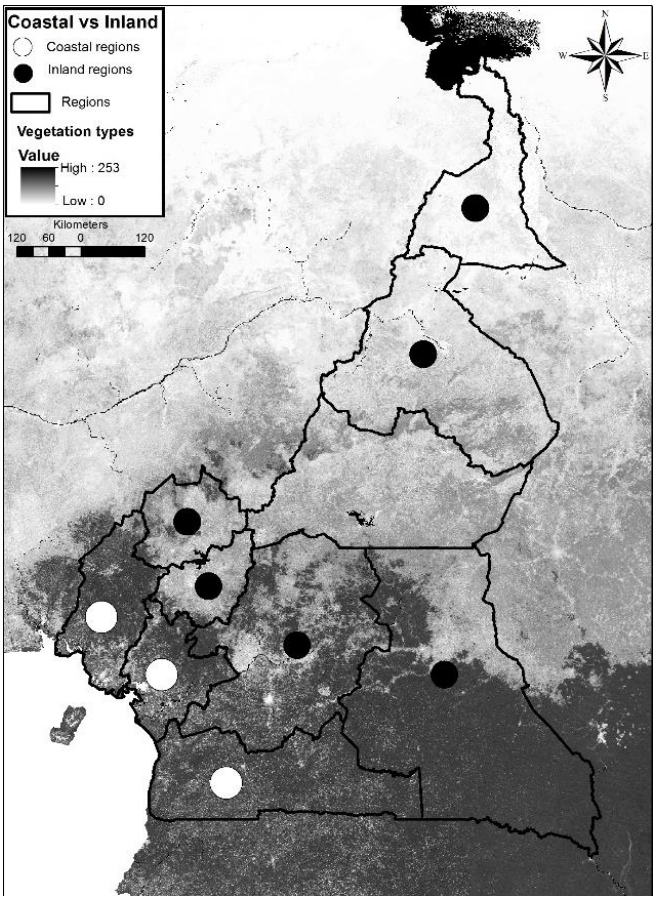


Figure 4.17: Coastal and inland regions: white circle, coastal regions; black circle, inland regions-Cameroon.

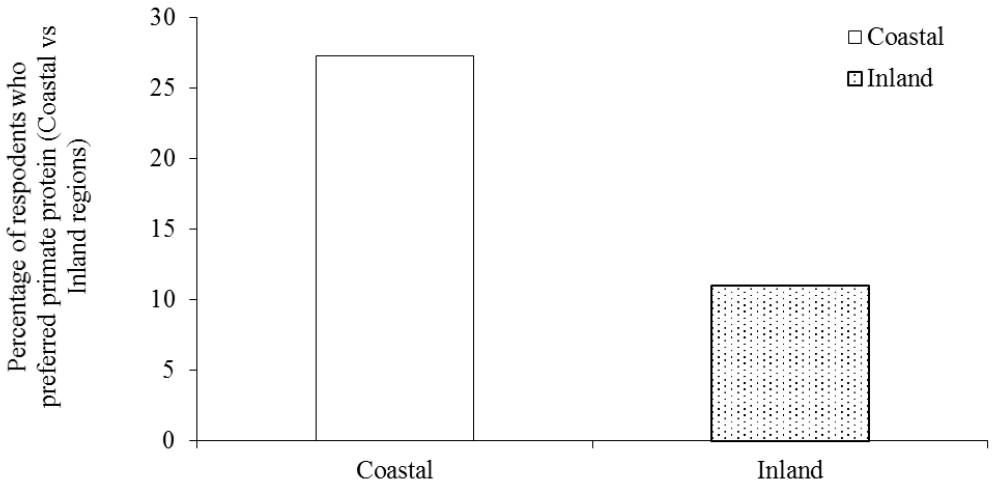


Figure 4.18: Primate protein preferences between coastal and inland regions in Cameroon.

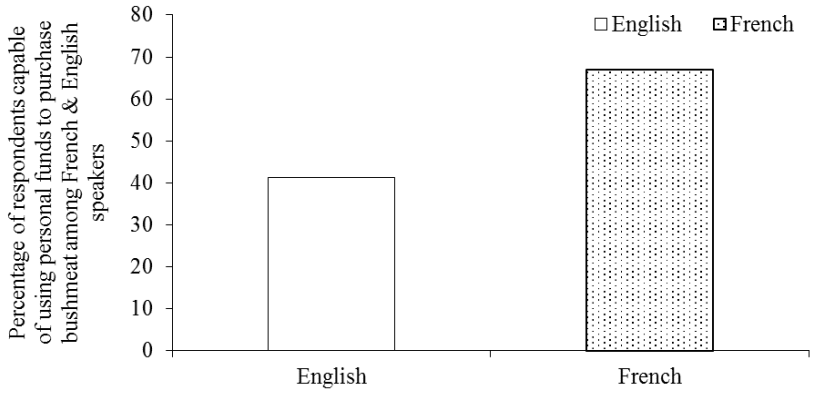


Figure 4.19: Use of personal funds to purchase bushmeat between French and English speakers in Cameroon.

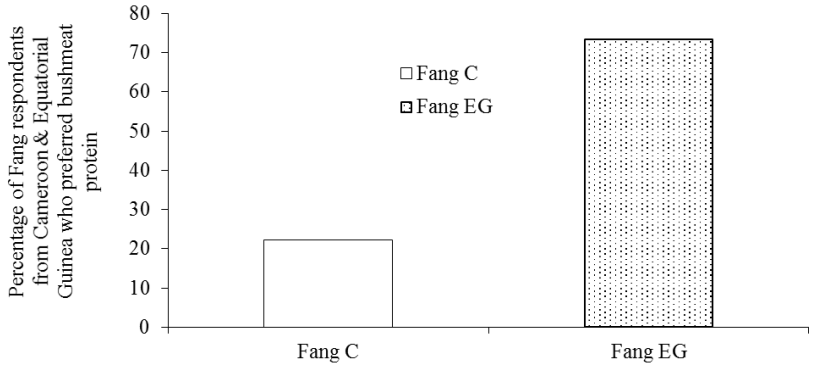


Figure 4.20: Bushmeat protein preferences between Fang from Equatorial Guinea and Cameroon.

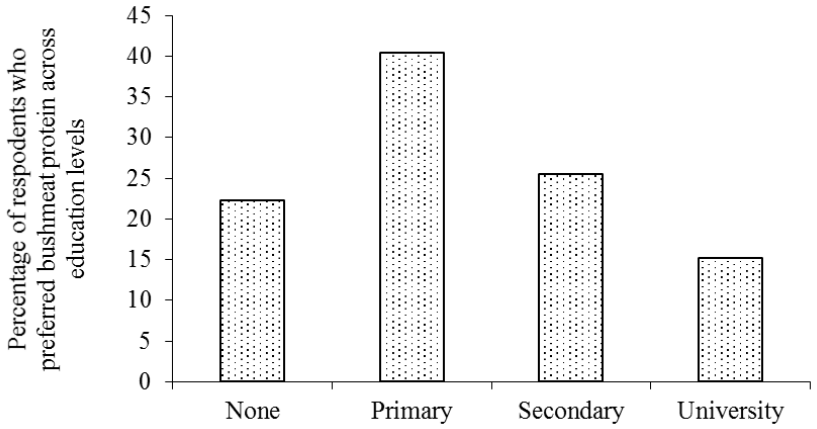


Figure 4.21: Bushmeat protein preferences across education levels in Cameroon.

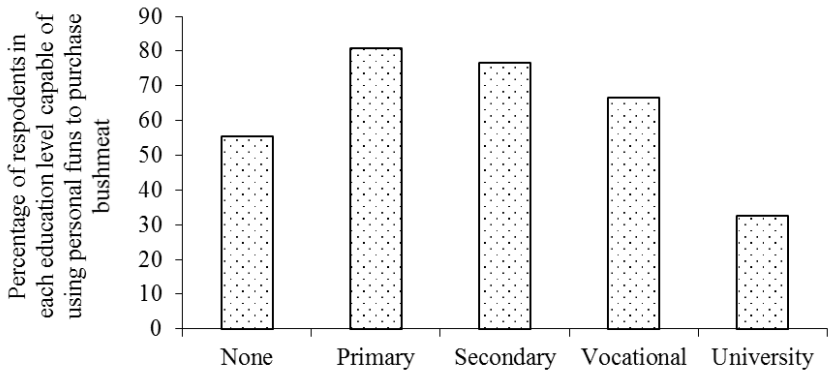


Figure 4.22: Use of personal funds to purchase bushmeat across education levels in Cameroon.

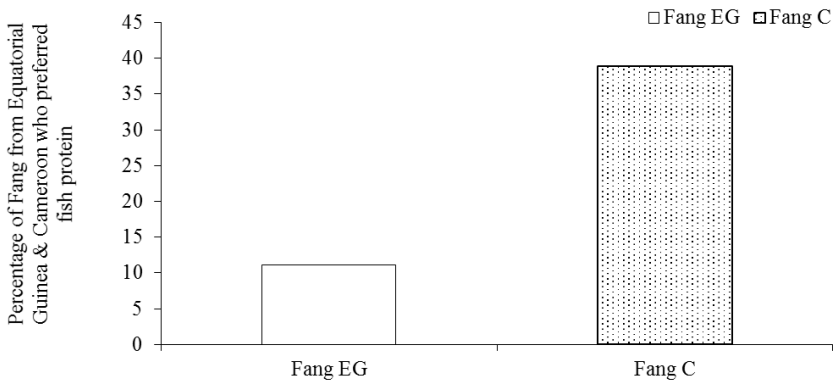


Figure 4.24: Fish protein preferences across Fang respondents from Cameroon and Equatorial Guinea.

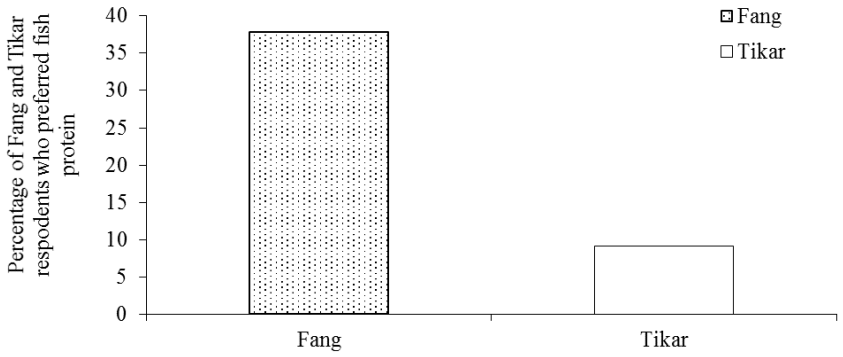


Figure 4.25: Fish protein preferences between Fang and Tikar respondents in Cameroon.

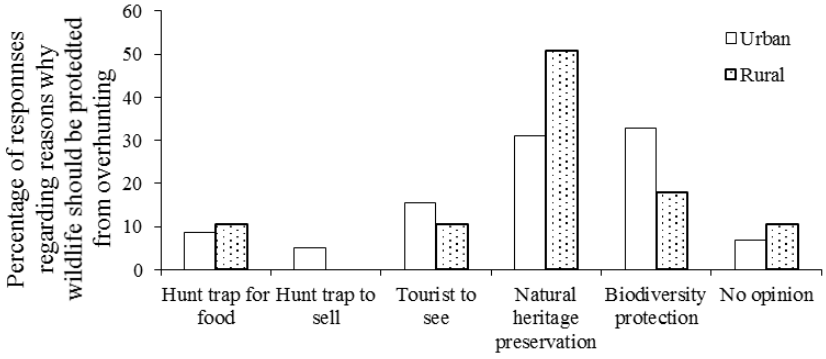


Figure 4.26: Reasons for protecting wildlife from overhunting between urban and rural respondents in Cameroon.

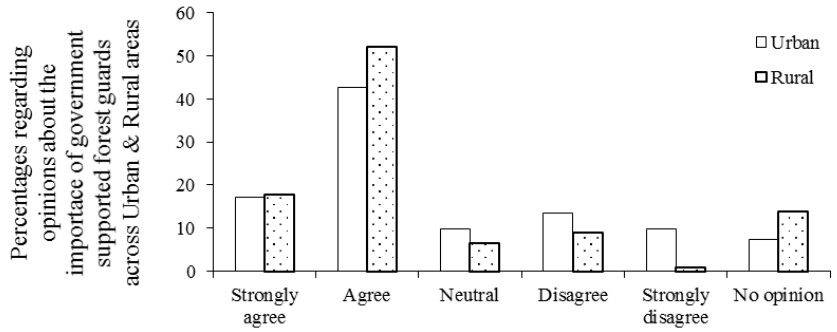


Figure 4.27: Opinions about government supported forest guards between urban and rural respondents in Cameroon

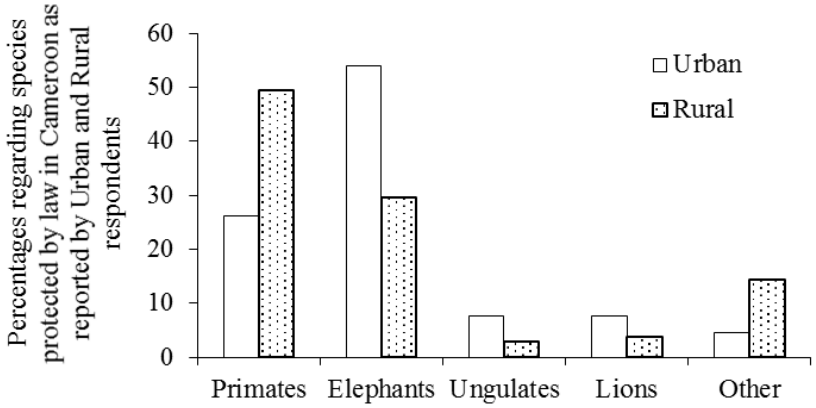


Figure 4.28: Species protected by law reported by urban and rural respondents in Cameroon**.**

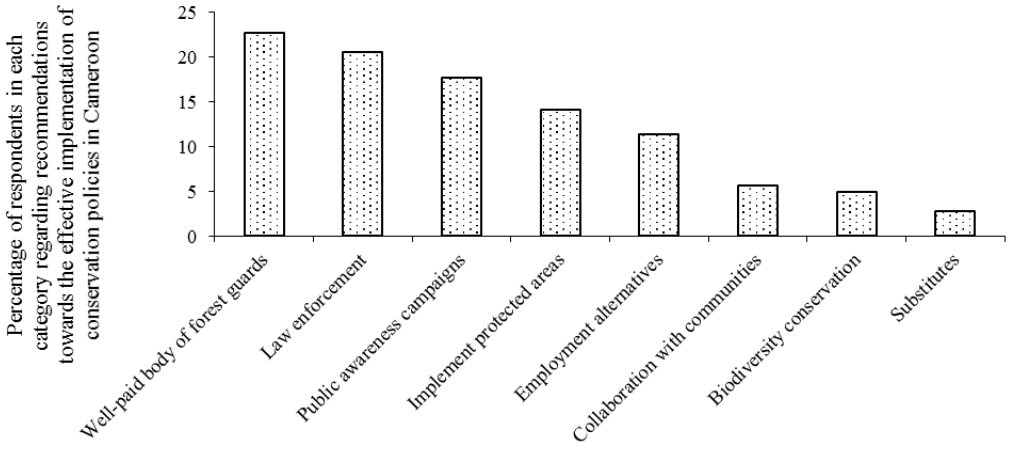


Figure 4.29: Recommendations about the effectives of conservation policies in Cameroon.

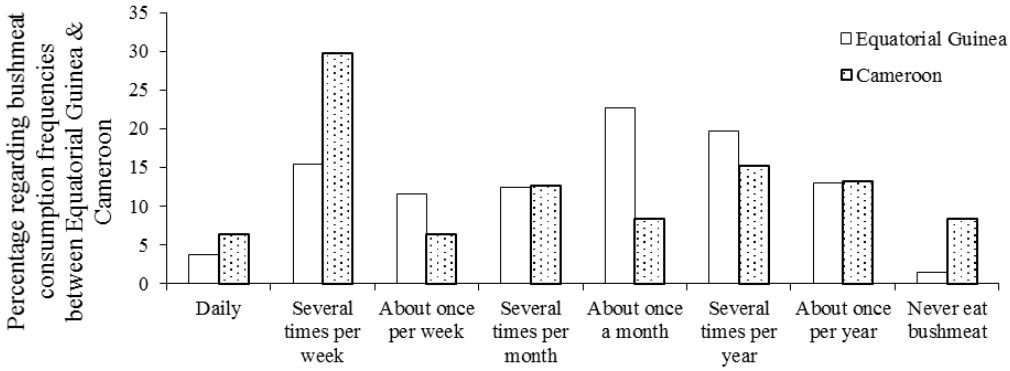


Figure 4.30: Bushmeat consumption frequencies between respondents from Bioko, Equatorial Guinea and Cameroon.

Chapter 5. Conclusions and Recommendations

The respondents in our surveys, although selected for participation by less defined criteria than is typical for public opinion surveys, did represent a reasonable cross section of consumers, both on Bioko Island and in Cameroon in distribution of sexes, age cohorts, locations, educational levels, ethnicity, and measures of socioeconomic status

Our most remarkable finding was the very high level of bushmeat preference amongst our Bioko Island respondents: 57% in our initial 2013 survey; and, 69% in our second 2014 survey. In our own Cameroon survey results, bushmeat preference (24%) ranked second behind those who preferred fish (26%). Chicken ranked third in all three of our surveys.

In contrast with the numerous food consumption studies that focus on wildlife harvest, food preference studies are rare. The few other studies on the mainland produced bushmeat preference levels similar to our Cameroon findings: For example, in the city of Bata in Rio Muni, East (2005) reported that 36% of interviewed households and 31% market consumers preferred bushmeat, well below the more popular fish (49% and 54%, respectively).

The only African food preference study that revealed a level of bushmeat preference similar to our Bioko Island rate was that of Njiforte (1996), now more than 20 years old. He reported a high preference (61%) for bushmeat over other sources of protein in his survey of 345 households in the two northernmost provinces of Cameroon.

Domestic meat (35%) accounted for most of the remaining preference. In addition to timing, the Njiforte study differed from ours in a number of ways: the habitat in northern Cameroon is grassland and woodland, not rain forest; the households interviewed were in villages and towns, none in a city; the most common occupation of participants was being a civil servant; and, there were many domestic animals (cattle), but no fish available for consumption. However, there were two key similarities: although respondents preferred bushmeat, most of them (78%) ate bushmeat less than once a week; and, there are nearby protected areas (the majority 5 out of 7 Cameroon's protected areas were in these two provinces) and respondents appeared to be very aware of the illegality of hunting in those areas (Njiforti 1996).

We also found that everyone on Bioko Island shared the fondness for bushmeat, with no significant differences associated with gender, location, or ethnic group. Although some earlier studies on the mainland (Pi & Groves, 1972; Fa et al., 2009) and on Bioko Island (Fa et al., 2002a) had found that the Fang were more likely to prefer bushmeat, our results indicate that this is no longer accurate for Bioko Island. Fang people living in Cameroon had a bushmeat preference rate that didn't differ from other ethnic groups living in Cameroon, but that was significantly lower than that of Fang people on Bioko Island, indicating that country-wide preferences, rather than ethnic group preferences, were more important in determining dietary choices.

We did, however, find significant differences between ethnic groups for the preferred species of bushmeat, and our results generally concurred with those reported

elsewhere in the region, especially the fondness of the Fang people for primate bushmeat. This preference is especially worrisome on Bioko Island where primates are now the principal endangered species threatened by hunting(Cronin et al. 2015; Cronin et al. 2016), and where there has been a large influx of Fang people in the last 25 years.

Most puzzling was the unexpected increase (from 57% to 69%) in the preference for bushmeat between our Surveys I and II on Bioko Island. We can think of only two possible causes: an internal bias resulting from the way we presented the question (more reference to actual "food choices", rather than "protein preferences") and an external influence, in particular the government concern over the Ebola crisis during the 6 months preceding our second questionnaire, which brought renewed attention to the dangers of hunting and handling bushmeat. Also, the volume of bushmeat available in the Malabo market was significantly lower than usual during this period. Some circumstantial evidence from the earlier Njiforte study in northern Cameroon lends support to the second cause, because that high bushmeat preference level was also in a region where enforcement of well-recognized hunting bans in nearby protected areas would jeopardize the livelihoods and bushmeat-eating traditions of local people.

The pattern of bushmeat consumption (as opposed to preference) for our two surveys on Bioko Island and our survey in Cameroon was typical for the region. People of Bioko Island don't eat bushmeat very often (most several times per month or less) and most don't regard it as an important component in their diet. Furthermore, attitudes towards wildlife protection on Bioko Island were generally positive, with 73% of the respondents

in favor of protecting wildlife from over-hunting, even to the extent of paying an "affordable fee" to achieve this goal. A majority of Bioko Island respondents were aware of televised outreach efforts to sensitize citizens to the plight of endangered primates on the island, and to the existence of the Moka Wildlife Center and its role in biodiversity conservation. Most of these same respondents claimed that these experiences (seeing the videos or visiting the wildlife center) had led to a change in attitude toward endangered wildlife. All of these are positive signs for wildlife conservation, but have not led to a decrease in bushmeat preference. Apparently the people of Bioko Island don't fully understand the connection between their love of bushmeat and the loss of endangered wildlife from their forests.

Most respondents on Bioko Island and in Cameroon, when asked how to achieve wildlife protection, selected supply side controls (enforcement of laws; well-paid forest guards) rather than demand side controls (awareness campaigns; alternative sources of income or protein). In this regard, it was interesting to examine the outcomes of the recommendations put forth 20 years ago by Njiforti to curb bushmeat hunting in northern Cameroon(Njiforti 1996). Clearly, Njiforti favored demand-side solutions. He recommended employing sustainable use practices like those underway at that time in Zimbabwe (Operation CAMPFIRE), in Rwanda (Mountain Gorilla Project) and in Uganda (Rwenzori Mountains Conservation and Development Project)(Njiforti 1996). He proposed farming, including domestication, of the two most popular game species, the North African porcupine, *Hystrix cristata,* and guinea fowl, *Numida meleagris*, based on experience from other parts of Africa (Njiforti 1996). A successful Guinea fowl

domestication and farming initiative by the Kainji Lake Research Institute in Nigeria was cited as a model, but an Internet search produced no subsequent information on the fate of this organization or this domestication project. Of course, attempts at wildlife farming (African giant snails and Emin's pouched rats) on Bioko Island were established at about the same time and rapidly failed, simply because the villagers of Batete realized that it was easier and cheaper to harvest snails and rats directly from the forest.

The other projects cited by Njiforti as examples of how community development could result in wildlife conservation did not report any success with these strategies on their present-day websites. Because Operation CAMPFIRE's sponsored activities included harvest of endangered species for sport hunting, it now has a rather negative international reputation. The well-known Mountain Gorilla Project, founded by Diane Fossey, and the less well-known Rwenzori Mountains Conservation and Development Project both enjoy continued support from WWF and other major donors. Neither organization mentions any successful sustainable use projects involving the farming or domestication of wildlife species; both organizations emphasize better enforcement of wildlife protection laws as the principal strategy for wildlife conservation. The WWF website notes the success of a collaborative forest management project that allows the collection of firewood and medicinal plants by local people, but makes no mention of bushmeat (presumably hunting remains entirely forbidden in the area of concern).

Although he clearly favored establishing an alternative source of bushmeat, either through farming or domestication, Njforti also gave equal attention in his

recommendations to the re-enforcement of anti-poaching activities and provision of basic management tools for the national parks. In this sense his recommendations reflect an increasingly accepted reality: government enforcement of wildlife protection laws remains the most effective method of preserving biodiversity and preventing the extinction of species endangered by bushmeat hunting.

Recommendations:

Biodiversity conservation on Bioko Island and throughout the country is ultimately the responsibility of the government of Equatorial Guinea. The government has enacted adequate (although far from exemplary) legislation to protect biodiversity and has signed appropriate international agreements to protect biodiversity. However, the government has failed to enforce these actions. Neighboring countries (Cameroon and Gabon) have made much more progress towards biodiversity conservation and can serve as models for Equatorial Guinea.

Recommendation #1: That the government of Equatorial Guinea enforce existing laws and treaties that protect biodiversity by 1) establishing teams of well-trained and well-paid forest guards in the protected areas, and 2) penalizing (fines for vendors) the illegal sale of protected species as bushmeat in the market.

Our research indicates that the citizens of Bioko Island are well aware of the laws protecting wildlife and are generally sympathetic to the plight of wildlife. However, the

repeated failure to enforce the laws may have contributed to the demise of endangered species by creating a Mardi Gras effect (Cronin et al. 2015), making government inaction equivalent to government collusion in species extinction.

Once protected areas are actually protected by forest guards, and once management plans are developed and implemented, the national parks should be developed as international tourist attractions. Because of its unique configuration and biogeographical history (African mainland plus volcanic continental island and oceanic island), Equatorial Guinea offers a variety of habitats and species for eco-tourists. A well-designed tour, especially in conjunction with Cameroon (Mt Cameroon and northern savanna), would result an appreciation for the value of wildlife at home, increased employment and revenue within the country and a better international image abroad.

Recommendation #2: That the government of Equatorial Guinea support the development of its protected areas and encourage the subsequent implementation of an innovative eco-tourism experience based on its unique biodiversity.

It is also possible to reduce the demand for bushmeat. The research reported in this dissertation illustrates that in nearby Cameroon, the preference for bushmeat has been greatly reduced, even among the supposedly bushmeat-loving Fang people, by the availability of fresh fish and chicken. Equatorial Guinea has not yet developed a fishing industry, or fish farming, or commercial poultry production, all practices now underway in Cameroon.

Recommendation #3: That the government of Equatorial Guinea encourage the development of domestic sources of fresh protein, especially fish and chicken.

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EDUCATION

Ph.D., Environmental Science Drexel University, Philadelphia, PA 2016
B.A., in Agroforestry Mechanical Engineering Universidad Nacional de Guinea Ecuatorial, Malabo, Equatorial Guinea 2007
Drexel University English Language Center, Philadelphia, PA
Intensive English courses, Levels 4-6 July- September 2008; June-September 2009
International Teaching Assistantship Program, Drexel University, Philadelphia, PA August 2010

PROFESSIONAL EXPERIANCE

Assistant Manager, Bioko Biodiversity Protection Program (BBPP)
Moka Wildlife Center, Bioko Island, Equatorial Guinea 2007-2010
Expedition Coordinator, BBPP Gran Caldera Expedition 2008-2010
Teaching Assistant, Drexel University 2010-2014
Research Assistant, Drexel University 2015-2016

AWARDS

Nominated for the Teaching Assistant Excellence Award, Drexel University 2011

SELECTED INVITED PRESENTATIONS AND WORKSHOPS

Assessing Attitudes towards Biodiversity Conservation among Citizens on Bioko Island, Equatorial Guinea invited speaker and conference participant, American Museum of Natural History, New York, October 2014

Assessing Attitudes towards Biodiversity Conservation among Citizens on Bioko Island, Equatorial Guinea poster presentation, American Association for the Advancement of Science 2016 Annual meeting, Washington D.C, February 2016.

Assessing Attitudes towards Biodiversity Conservation among Citizens on Bioko Island, Equatorial Guinea poster presentation, Department of Biodiversity, Earth and Environmental Sciences' research day, Drexel University, Philadelphia, PA., April 2016

SELECTED PUBLICATIONS

D.T. Cronin, **D. Bocuma Meñe**, C. Perella, D. Fernández, G.W. Hearn, and M.K. Gonder. 2015. The Future of the Biodiversity of the Gran Caldera Scientific Reserve: Translating Science into Policy to Develop an Effective Management Plan for the Gran Caldera Scientific Reserve. A report prepared for the Symposium on the Future of the Biodiversity of the Gran Caldera Scientific Reserve by the Bioko Biodiversity Protection Program: Version 1.0, Philadelphia, 42 pages.

Cronin, D., **D. B. Meñe**, T. Butynski, J. Echube, G. Hearn, S. Honarvar, J. Owens, and C. Bohome. 2010. Opportunities Lost: The Rapidly Deteriorating Conservation Status of the Monkeys on Bioko Island, Equatorial Guinea (2010). A report to the Government of Equatorial Guinea by the Bioko Biodiversity Protection Program, Drexel University, Philadelphia, PA.

LANGUAGE SKILLS

Fluency in Bubi (native dialect), Spanish, and English